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Symposium: The Nonsurgical Treatment of Strabismus

THE MANAGEMENT OF SUPPRESSION AMBLYOPIA

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THE panel for this symposium will discuss the nonsurgical management of strabismus. Although surgery may be the dramatic method of treatment for strabismus, a muscle operation is decided upon only after careful evaluation and preparation of the patient, and must frequently be followed by orthoptic management. The sensory abnormalities associated with strabismus may be treated effectively only by nonsurgical methods. Suppression amblyopia is the most serious of these sensory abnormalities, and its management is the topic of this paper.

The classic concepts in amblyopia attributed the reduction of acuity in vision to suppression alone. Eccentric fixation was recognized rarely and only in cases where the optic axis was obviously far from proper alignment during attempted fixation with the amblyopic eye alone. We now know that nonfoveal monocular fixation occurs commonly and is of great significance in determining the type of treatment and the prognosis.

Fixation behavior of the eye during monocular use may be classified as central or eccentric. *Central* fixation refers to true foveal fixation. *Eccentric*, or nonfoveal, fixation may be further subdivided into parafoveal, paramacular, peripheral, and erratic fixation (fig. 1). *Parafoveal* fixation refers to fixation with a portion of the retina within two degrees of the fovea, but not with the fovea itself. Use of a fixation point situated between two to four degrees from the fovea is termed *paramacular*. *Peripheral* fixation refers to use of some portion of the retina more than four degrees from the fovea. The patient whose eye wanders constantly, with no definite area of preference, is said to have *erratic* fixation. These fixation habits may be either steady or unsteady. *Steady* fixation is the constant and unwavering use of the preferred retinal area. *Unsteady* fixation is variable and uncertain, although a given area may repeatedly oscillate into the fixing position.[6]

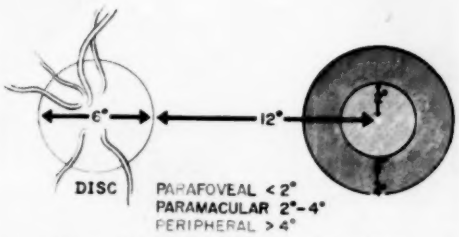

FIG. 1—Illustration of fixation nomenclature.

Dr. Havener is Professor and Chairman, Department of Ophthalmology, The Ohio State University, and Dr. Harris is Assistant Resident in the Department.

Presented at the *Special Program* of the American Orthoptic Council and the American Association of Orthoptic Technicians, Oct. 9, 1960, Chicago.

Recognition of the smaller amounts of eccentric fixation requires ophthalmoscopic observation of the retina during fixation. This is done by projecting a fixation pattern upon the retina simultaneously with observation of the fundus. The Visuscope is an ophthalmoscope specially designed for simultaneous observation of the retina and projection of the fixation pattern. In the ordinary ophthalmoscope, the rotating disc of lenses does not alter the emerging light, but focuses the returning light from the patient's eye to form a clear image upon the observer's retina. In the Visuscope, the rotating lenses are in front of the light beam emerging from the instrument and therefore modify the focus of light upon the patient's retina. In addition, a number of test patterns and filters may be rotated into the optical system. To determine fixation, a bull's-eye target pattern with a central fixation star is placed in the system and focused sharply upon the patient's retina with use of the rotating lenses. The patient is instructed to look at the star. Since the bull's-eye and central star patterns are easily seen as they are being projected upon the retina, their relationship to the foveal light reflex is readily observed (figs. 2 and 3).

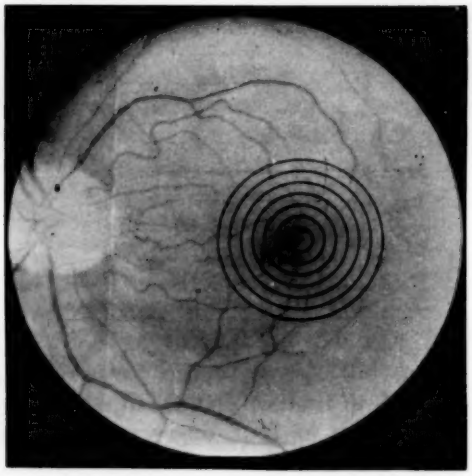

FIG. 2—Visuscope pattern in central fixation.

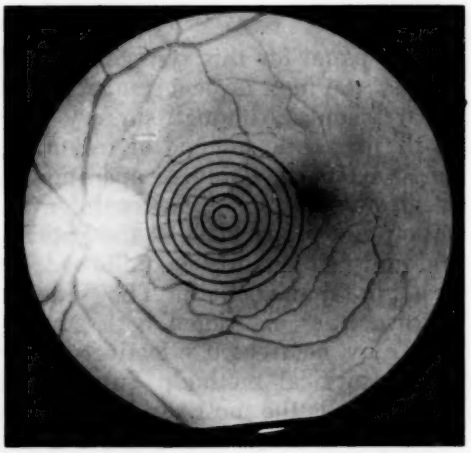

FIG. 3—Visuscope pattern in paramacular eccentric fixation 3 degrees nasal to fovea.

Each concentric ring in the bull's-eye target represents a half degree of angular displacement. The pupil must be reasonably large for accurate viewing of the macular area.

The uninstructed child has a remarkable tendency to fixate the center of this bull's-eye target, thereby permitting study of fixation habits even in a 2-year-old child. Examination of the good eye will indicate whether the patient is trying to fix centrally. Comparison is made of the fixation with the good and with the bad eye. Consistent use of the foveal area of the good eye and the nonfoveal area of the bad eye establishes the diagnosis of eccentric fixation. Obviously, this determination cannot be made in the uncooperative child who avoids the light.

Determination of fixation with the Visuscope is a simple procedure with few possibilities of error. Among these possibilities are:

1. Hysterical amblyopia. We have observed hysterical patients whose fixation is wavering and closely resembles the unsteady fixation of some amblyopes. This condition is usually bilateral in children.

2. Inattention. Grossly variable, wandering movements are readily differentiated from the fine oscillation of amblyopic unsteady fixation, and will be bilateral.

3. Variable foveal reflex. Infrequently, lateral displacement of the ophthalmoscope will cause a considerable shift of the foveal light reflex upon the retina. Presumably this is due to physiologic variation in the depth of the foveal depression. Such a patient may be fixing centrally despite an eccentric position of the foveal reflex. This condition is bilateral and may be recognized by shifting the position of the ophthalmoscope sideways.

4. Presence of a dense central scotoma. The patient with a central scotoma (e.g., retrobulbar neuritis) will not see the star unless he fixes eccentrically. Obviously, therefore, eccentric fixation may be caused by retinal or nerve disease, as well as by suppression amblyopia.[2]

The fixation characteristics of an eye with steady eccentric fixation cannot be altered simply by occluding the good eye. Such occlusion will simply reinforce the habitual use of the eccentric fixating area. Since eccentric fixation and suppression amblyopia may coexist, occlusion of the good eye may improve vision of the eccentric and suppressed eye—but this improvement in acuity will be limited to the anticipated normal acuity for this eccentric area. As is well known, precipitous decrease in acuity normally occurs when fixation is shifted from the foveal to more peripheral regions of the retina.[1] We have plotted the visual acuity of amblyopic patients against the degree of eccentricity as determined by the Visuscope (fig. 4). In no instance was acuity better than normally anticipated for the given eccentric position. Frequently acuity was less than anticipated, indicating suppression of the eccentric area.

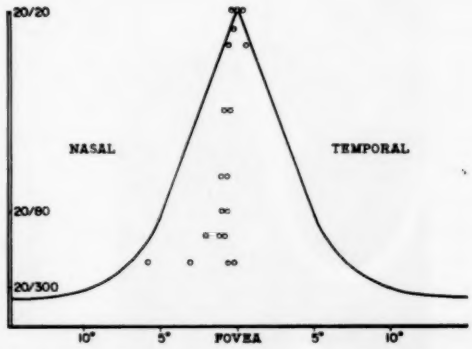

FIG. 4—The line represents normal visual acuity, with its foveal peak. Each dot represents the visual acuity of an amblyopic patient, charted against the eccentricity of his fixation.

Knowledge of these facts and use of the Visuscope will permit the ophthalmologist to predict with reasonable certainty the response of a given child to occlusion therapy. The child with foveal fixation may attain normal vision; he, therefore, deserves vigorous occlusion therapy until this goal is reached. The child with eccentric fixation may please and encourage the parents and physician by initial visual improvement, but even the most prolonged occlusion will not further improve acuity. The old maxim, occlude until six weeks after

the last demonstrable improvement, is still a safe guide in these cases of eccentric fixation. No further improvement in vision can be attained by occlusion if the residual defect is due to eccentricity, not suppression.

Because simple occlusion of the good eye is the only available treatment in most areas, such occlusion should usually be recommended for amblyopic children under the age of 6 years, just as in the past. A very practical point should be emphasized. If vision is partially restored to an eccentrically fixing eye, partial occlusion must be continued until the child is 7 or 8 years of age at least. Failure to continue partial occlusion may result in a return of the suppression portion of the amblyopia—an unfortunate occurrence.

If special facilities are available for pleoptic treatment, the eccentrically fixing eye should be occluded (*not* the good eye). Such complete occlusion is continued for at least several weeks before beginning treatment. Following this, it may be possible to convert the eccentric fixation to foveal fixation by means of daily applications of dazzling bright light to the eccentric areas and subsequent stimulation of the undazzled fovea (fig. 5). This requires a great deal of effort and time. Detailed discussion of technique is not appropriate. In general, the dazzling light should include the area of eccentric fixation and must spare the fovea. The resulting scotoma will last ten to fifteen minutes, blocking use of the eccentric area during this time. While the dazzle-scotoma persists, the fovea is stimulated with rapid flashes of light (of nondazzling intensity) directed exactly centrally with telescopic observation by the orthoptist.

FIG. 5—The Pleoptophor in use.

If treatment is sufficiently frequent and prolonged in the majority of patients central fixation can be restored. Instruments employing the Haidinger brush phenomenon, which is seen only with the central portion of the retina, are also used to effect the transition to central fixation. Once central fixation has been securely established, further visual improvement is attained by standard occlusion and training methods. Patients treated in this manner may attain improvement in acuity impossible by ordinary methods. Usually, however, true binocular vision is not achieved.

The time-honored technique of prolonged total occlusion of the dominant eye is still the method of choice for treatment of young patients with foveal fixation in the amblyopic eye. The following comments on standard occlusion therapy deserve mention in a symposium such as this:

A. The fixation behavior of the eyes is a more accurate guide to occlusion than is measurement of visual acuity. Fortunately, the ability to fixate can be observed accurately in very young children and serves as our guide to the effectiveness of occlusion. The ideal end result of occlusion therapy is freely alternating fixation. Unless a child's two eyes are used equally, or are straight, the deviating eye will again relapse into amblyopia. Attainment of 20/20 vision in the amblyopic eye, although nice to demonstrate to the parents, is not synonymous with equal usage of the two eyes. Rough estimates as to visual acuity may be made on the basis of fixation behavior. Eyes which alternate freely usually have equal vision. If the deviating eye fixes and holds well even when the good eye is uncovered, its vision is estimated to be somewhere between 20/30 and 20/100. The eye which fixes, but will not hold, probably is capable of vision between 20/50 and 20/200. Of course, it is well known that the eye with grossly detectable eccentric fixation will see no better than 20/200.

B. Occlusion therapy is a nuisance and will not be carried out unless the parents are convinced of its necessity. I accomplish this by giving them a short article entitled "Is Your Child Blind in One Eye?" and by pointing out that the child's efforts to remove the bandage are his only way of indicating that he sees so poorly with the other eye that it requires treatment. The mother who realizes this will view attempts at bandage removal with much less tolerance than the mother who sympathizes with the child's inconvenience or distress.

C. The initial occlusion period should not be prolonged for more than a week in a very young child. Transfer of amblyopia to the previously dominant eye may occur within a week in an infant. Such transfer is encouraging, since it invariably indicates that proper care will ensure equal acuity in both eyes. An initial occlusion period of a month, in such a case, will result in severe amblyopia of the previously fixing eye. This is distressing to the parents and to you as it requires considerable occlusion of the newly-dominant eye to restore equal fixation.

D. Recurrent amblyopia may occur until the child is 8 years of age. For this reason, strabismus patients should be checked at least every four months until they are eight years old. Such routine checking is particularly important if the eyes are not perfectly straight and fixation does not alter-

nate freely. Less attention is required by the child who has attained perfectly straight eyes with equal acuity and good binocular vision.

E. Partial occlusion is effective when the method used causes the patient to fix with the amblyopic eye. These methods include atropinization of the good eye, blocking the spectacle lens in front of the good eye either partially or completely with opaque tape, or blurring the lens with fingernail polish or translucent tape. Partial occlusion will maintain vision in an eye which had regained acuity by total occlusion, but which cannot be made perfectly straight and does not alternate freely. Methods of partial occlusion which maintain peripheral fusion can be used to treat amblyopia in the presence of a high phoria. Use of total occlusion in the presence of a high phoria involves the risk of precipitating a tropia which may require surgical correction.

F. Astigmatic or anisometropic errors should be fully corrected. The common practice of giving the spherical equivalent instead of a cylinder is mentioned only to be condemned. A greater optical defect is ordinarily found in the amblyopic eye and is probably the main reason for deviation of this eye and subsequent suppression amblyopia. Although many ophthalmologists believe that at least 2 diopters of anisometropia are necessary to produce amblyopia, this is perhaps not always true. Amblyopic eyes are encountered which are both straight and isometropic. Possibly strabismus or anisometropia existed earlier and has disappeared, or perhaps another unrecognized cause exists.[7]

G. Recognition of an isolated symbol, such as an E block, is not by itself an adequate test of amblyopic vision. The amblyopic eye cannot interpret groups of symbols and the use of a line of print is a much more reliable test. The attainment of 20/20 E block vision may not be a criterion for maximum restoration of vision; alternate fixation is a preferable goal, and should be achieved before surgical correction.

H. Occlusion of the good eye for reasonable periods of time is less likely to restore vision in children over the age of 7 years. A few physicians, hearing rumors of the possibility of improving amblyopic vision, have erroneously concluded that standard methods of occlusion may be used successfully at any age.

DIFFERENTIAL DIAGNOSIS

Since the advent of pleoptic treatment, accuracy in the diagnosis of suppression amblyopia has become increasingly important. Pleoptic treatment is difficult and time consuming, and should not be undertaken in cases of organic visual loss, which cannot be benefitted.

The diagnosis of suppression amblyopia is suspected in cases of monocular loss of vision present from early childhood, uncorrectable optically, occurring in ophthalmoscopically normal eyes which have deviated during childhood or which are anisometropic. A diagnosis made upon the basis of these characteristics may be confirmed by perimetry, by the filter test, or by a trial of occlusion if the patient is under 6 years of age.

Testing the central field under both monocular and binocular conditions may be diagnostically helpful in cooperative older patients. This is done

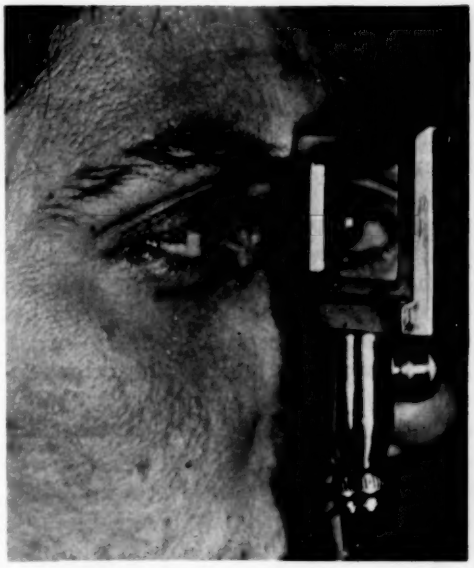

FIG. 6—The position of the fixation mirror before the good eye during binocular plotting of amblyopic fields.

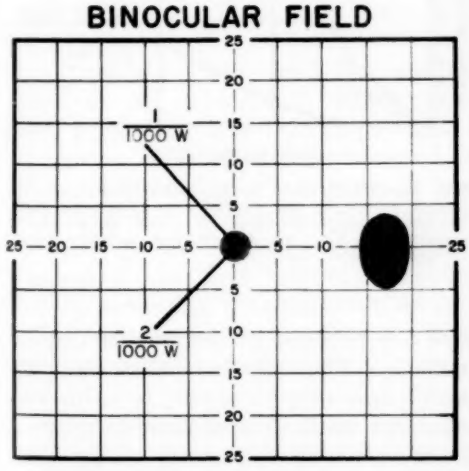

FIG. 7—Typical relative central scotoma of amblyopic eye, measured under binocular conditions.

by placing a mirror in front of the good eye in such a manner that the eye fixes upon a light to the side of the mirror, but is blocked from seeing the tangent screen (fig. 6). The field of the amblyopic eye is then charted as usual, but with both eyes open. Many amblyopic eyes will have a definite central scotoma with binocular testing (fig. 7) but not with monocular testing.[8] A scotoma due to organic disease is the same whether tested monocularly or binocularly.

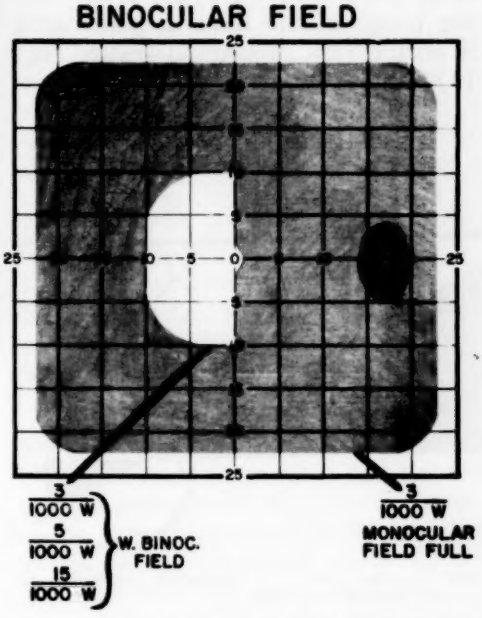

FIG. 8—Typical hemiretinal scotoma of amblyopic eye.

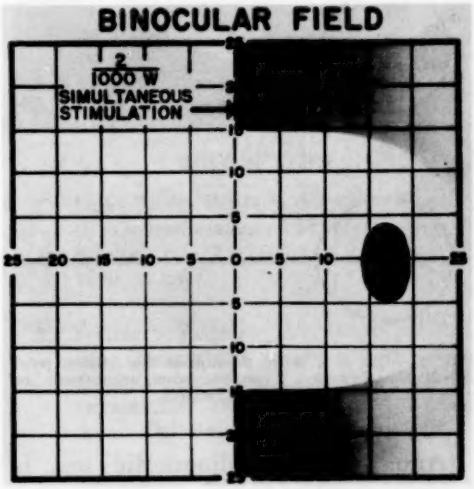

FIG. 9—Relative hemiretinal suppression scotoma demonstrable only by technique of simultaneous stimulation.

The amblyopic scotoma is characteristically hemiretinal (fig. 8) extending from the fovea to the portion of retina directed straight ahead in the deviating eye (fig. 9). The extent of this scotoma (fig. 10) may be measured by a perimetric test object, or by using a rotary prism to displace the image of the fixation point until it escapes the suppressed region (fig. 11).[3,5]

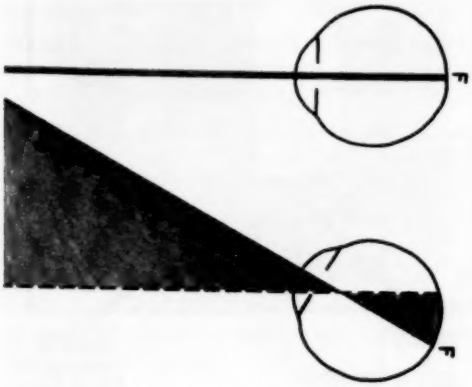

FIG. 10—The extent of a hemiretinal suppression scotoma as projected into space.

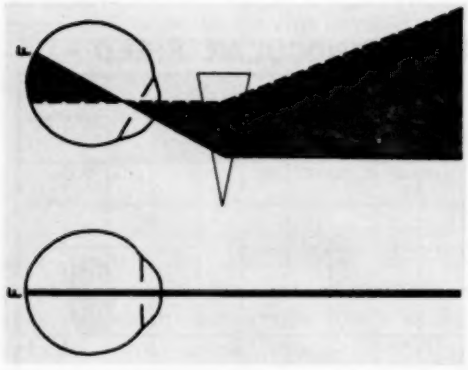

FIG. 11—Use of a prism to displace the fixation point outside the scotoma. When the prism overcorrects the deviation, diplopia will be appreciated.

Another useful diagnostic test is measurement of visual acuity through a filter sufficiently dense to reduce the vision of a normal eye to 20/30. Such a filter may readily be obtained by combining the red and green glasses which are standard equipment in most trial sets. Through such a filter, a normal eye will see 20/30, an amblyopic eye will see exactly the same as without the filter, and a diseased eye will see a great deal less than without the filter.[9] The explanation of this behavior is best understood by examining a graph in which visual acuity is plotted against illumination (fig. 12). On this graph, the acuity of both the normal and of the diseased

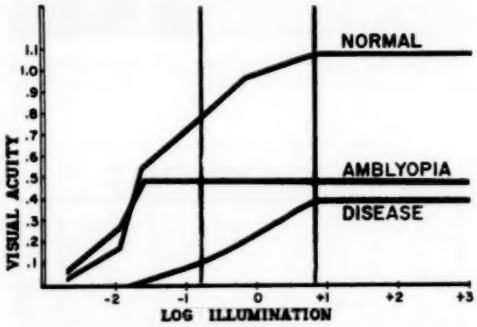

FIG. 12—Plot of visual acuity against illumination, for normal, amblyopic, and diseased eyes. The right vertical line indicates the levels of acuity under normal illumination. The left vertical line indicates acuity through the dense filter.

eye are reduced by decreasing illumination. The visual acuity of the amblyopic eye, however, remains unchanged until illumination drops to a level at which the acuity of the normal eye has fallen to the amblyopic acuity.[10] We have found this filter test to be a reliable method of differentiating amblyopic and organic visual loss. Obviously, it requires a patient old enough to report visual acuity reliably.

Perhaps the most convincing diagnostic test for suppression amblyopia is a trial of occlusion therapy—pro-

viding the child is under 6 years of age. Improvement of vision is interpreted to confirm the diagnosis of amblyopia (although subsiding disease or hysteria would give a similar result). Failure to better vision does not exclude amblyopia, since unfaithfulness of occlusion, the duration of amblyopia, or the use of an eccentric retinal area for fixation may prevent improvement.

RECOMMENDATIONS

The new pleoptic techniques have specific indications in the treatment of amblyopia with eccentric fixation. The incidence of amblyopia in general, however, would be made less, if every child with strabismus were cared for by a competent ophthalmologist within a month of onset of the deviation. This early care will not be achieved until all physicians are aware of the need for prompt referral of strabismus. Many doctors apparently do not know that a squinting child should be referred to the ophthalmologist as soon as the strabismus is recognized. Education of the public should also be encouraged. In this respect preschool vision screening programs are doubly effective; they spread information as well as detect eye disorders.

All parents who consult us about strabismus or amblyopia should be told that future squinters are likely to occur in these family groups, so that when they appear, the need for returning to the ophthalmologist for advice and therapy will have been anticipated by the parents.

Finally, recruitment of new orthoptists must be more vigorous than in the past. Training opportunities outnumber trainees. Our ideal of comprehensive medical eye care for all patients will be achieved only when we have the help of adequate numbers of trained aides such as orthoptists.

SUMMARY

Either suppression amblyopia or eccentric fixation or both may be responsible for decreased vision in a deviating eye. Determination of fixation behavior with the Visuscope is clinically useful because it permits more accurate prediction of the degree of improvement which can be attained by occlusion of the good eye. Such occlusion may be an effective remedy for amblyopia, but it does not alter eccentric fixation.

Pleoptic techniques are often effective in restoring central fixation, but they are time consuming and require special equipment. For practical purposes, the ophthalmologist who wishes to do pleoptic training needs an orthoptist with this special training.

The most effective approach to the problem of amblyopia is education of the general medical profession and the public in the importance of early ophthalmologic care in the management of strabismus.

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Symposium: The Nonsurgical Treatment of Strabismus

THE MANAGEMENT OF THE SENSORY ANOMALIES

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IT is the purpose of this paper to present the orthoptic management of the sensory anomalies. Immediately following the onset of acquired heterotropia there is a breakdown of binocular single vision. In congenital heterotropia, normal binocular vision cannot develop, and the binocular reflexes are adapted to an anomalous way of seeing. A satisfactory correction of heterotropia implies not merely alignment of the visual axes, but also the awakening, or re-education, of normal binocular responses.

The sensorial adaptations to heterotropia, excluding amblyopia will be considered under the following headings:

1. Normal sensory findings
2. Sensory adaptations to heterotropia
3. Routine clinical tests
4. Methods of treatment
5. Treatment in relation to specific diagnoses

NORMAL SENSORY FINDINGS

The normal sensory findings are diplopia with correct localization of the images, and confusion. These must be recognized in order to understand the resulting adaptations. A psychologically accepted diplopia is sometimes found in cases of heterotropia of early onset. This finding is rare, but it indicates that no adaptation has been made. However, a diplopia which is not acceptable but is of great annoyance is often seen in heterotropia acquired by children older than five years of age.

On the other hand, confusion is sometimes reported, and is described as two different images localized in the same place due to normal functioning of both maculas. It is occasionally reported in cases of intermittent exotropias, and in adults who are apparently unable to suppress. To these individuals, the confusion of images is apparently more disturbing than the diplopia.

SENSORY ADAPTATIONS TO HETEROTROPIA

The onset of heterotropia most often occurs in early childhood, at a time when the binocular mechanism is undergoing development, and is therefore unstable and plastic. By the same token, it is amenable to adaptation, which is acquired to exclude diplopia and confusion. These adaptations are effected by (1) pathological suppression; (2) anomalous retinal correspondence or (3) the blindspot adaptation of Swan.

Presented at the *Special Program* of the American Orthoptic Council and the American Association of Orthoptic Technicians, Oct. 9, 1960, Chicago.

Pathological Suppression

In this adaptation, the visual images received on the noncorresponding retinal areas of the deviated eye are inhibited. The suppression may be (a) *uniocular* as found in constant unilateral deviations; (b) *alternating*, as occurring in either eye, depending on which is the fixating eye at the time of testing; (c) *conditional* or *facultative*, when it occurs under certain conditions, for example, in the exotropic phase of intermittent exotropia; or (d) *unconditional* or *obligatory* suppression, as seen in long-standing deviations, usually of the uniocular type, and also in some cases of alternating heterotropia.

Anomalous Retinal Correspondence

This is an alternative method of adaptation in which suppression inhibits normal retinal correspondence and is supplemented by a mental reorientation of the images received on noncorresponding retinal areas. These images are then localized in subjective space, correctly relative to the misalignment of the visual axes, and incorrectly relative to normal subjective localization. In suppression alone, there is a negation of any binocular visual response, whereas in anomalous correspondence, the noncorresponding areas of the retinas acquire a common visual direction.[1] Anomalous retinal correspondence is therefore a binocular sensorial adaptation to the heterotropia whereby the subjective localization of objects in space is made as if the eyes were straight. It may be diagnosed in small or large degrees of esotropia or exotropia, as also in the exotropic phase of intermittent exotropia. It may also be found in varying stages of development or fixity. There are two classifications of anomalous retinal correspondence, which could possibly be two stages in development. The first is harmonious, signifying that the adaptation, or angle of anomaly, is equal to the degree of the deviation; the second is unharmonious, in which the adaptation is less than the angle of deviation. The usefulness of the latter as a form of binocular cooperation is questionable. It has been suggested that it is merely a stage in development toward the acquisition of a harmonious abnormal retinal correspondence, or that it is the result of a change in the degree of the motor deviation after it had been acquired.[3]

The Blindspot Adaptation of Swan

Swan, in 1954 described use of the physiological blindspot to avoid diplopia.[6] As such it is classified as a sensorial adaptation. Suppression of varying degree must accompany this method of adaptation if all symptoms of diplopia and confusion are to be avoided. The object of attention imaged on the macula of the straight eye is projected on the optic nerve of the esotropic eye, in deviations for twenty-five to thirty diopters. Since there are no retinal receptors at the optic nerve head, there is no visual image, and suppression is not necessary. However, suppression is necessary to inhibit the visual reception of the images falling on the noncorresponding areas of the retina not covered by the blindspot. The area of subjective space covered by the blindspot varies directly with the distance of fixation, *increasing* in size with distance.

The sensorial adaptations to heterotropia have been stated; their degree of stability or fixity will depend on time, usage, and the adaptability of the individual. The earlier the onset of the deviation, and the longer its duration, the more fixed the sensory anomalies become. Since the aim of

orthoptic treatment is to correct the adaptations and to stimulate the normal, some estimation of the degree of fixity of the acquired seeing habits should be made. It should be understood that orthoptics cannot correct all cases of abnormal sensorial patterns, nor can the child be trained to fuse when there has been no development of fusion prior to his fifth year of age. Therefore, orthoptics may be a waste of time, uneconomical, and in some instances contraindicated. For example, orthoptics should not be undertaken when unmasking of suppression would produce an annoying diplopia without reasonable hope for fusion.

ROUTINE CLINICAL TESTING

In evaluating the sensory correspondences, the following tests are commonly used:

Double Image Test

A single light source is used as a fixation target, together with a red filter over one eye, or the red and green goggles. The responses to this test may indicate (1) mild suppression, when diplopia is elicited merely by use of a colored filter; (2) marked suppression, either monocular or alternating, when diplopia is appreciated only by the introduction of prisms which displace the rays of light to fall on nonsuppressing areas; (3) normal retinal correspondence, shown by normal localization of the images as the deviation is first undercorrected then overcorrected by prisms of known strength; (4) abnormal retinal correspondence, wherein correction of the deviation with prisms produces incorrect localization of the images. The approximation of the images in the zero position indicates harmonious abnormal retinal correspondence (ARC) whereas the approximation of the images at an angle less than the objective angle indicates unharmonious abnormal retinal correspondence.

Major Amblyoscope

The subjective responses of the patient with use of this instrument enable definition of the areas and the type of suppression, and can demonstrate the presence of either normal or anomalous retinal correspondence. The grades of binocular vision may be assessed according to the type of target used.

In making a diagnosis of either normal or anomalous correspondence on the amblyoscope, notation should be made of whether there is a definite subjective angle (superimposition of the images), or whether the images are merely seen to cross one another, but are never actually superimposed. The size of the target used should also be recorded. In America, it is customary to classify as anomalous correspondence not only those cases with a definite anomalous subjective angle, but also those showing a crossing 'false,' the latter indicating that there is no superimposition of the images, but that the area over which the images are seen to cross does not coincide with the objective angle of deviation. However, most English orthoptists classify only those patients with a definite anomalous subjective angle as having abnormal retinal correspondence. It is possible that this difference in interpretation of findings contributes largely to the diversified views among orthoptists concerning the prognosis in anomalous retinal correspondence. Some orthoptists believe that every case of anomalous

retinal correspondence can be cured, while others state none can be cured. From my own experience, I believe that the presence of a definite anomalous subjective angle when foveal targets are used generally indicates a poor prognosis, whereas in the crossing "false" finding, the anomalous correspondence may be more poorly defined and therefore more amenable to therapy.

In testing for fusion on the amblyoscope, the phenomenon described as *horror fusionis* should be kept in mind. This is seen when the patient, in attempting to fuse the images, sees them for an instant together but generally moving vertically or crossing each other horizontally. The absence of suppression, together with the absence of sensory fusion, excludes hope for a functional result.

The prognosis is poor when the fusion targets are superimposed at an angle much in excess of the simultaneous perception angle. This indicates that accommodative convergence is being used in an attempt to obtain fusion by motor responses alone, in the absence of sensory fusion.

The Afterimage Test

The afterimage test requires the description of positive and negative afterimages, demanding perceptive cooperation from the patient. Afterimages showing normal subjective macular localization, that is, normal retinal correspondence, even though other tests for retinal correspondence show abnormal correspondence, indicate the anomalous correspondence is not deeply rooted. On the other hand, abnormal localization of the afterimages indicates a stabilized abnormal retinal correspondence, contraindicating orthoptic treatment.

Double Image Test with Lancaster Screen Apparatus

Wearing the red and green glasses, the patient controls either the red or the green flashlight while the examiner controls the other. The patient is asked to superimpose the red on the green image. The following responses may be obtained:

1. The patient may be unable to observe both lights at the same time indicating marked suppression; it may be monocular or alternating.

2. The patient may claim superimposition of the lights showing a displacement of images equal in degree to the angle of deviation, indicating normal retinal correspondence.

3. The superimposition of images claimed may be observed with a displacement less than the degree of deviation, or in the same place as if the goggles were not being worn. This indicates, in the first instance, unharmonious and, in the second, harmonious, anomalous correspondence.

4. The patient may superimpose his light twelve to eighteen degrees away from the examiner's light. In cases of esotropic deviation this would be classified as a blindspot adaptation.

From the findings of these routine clinical tests, assessment is made regarding the desirability of orthoptic treatment. Test results contraindicating orthoptic treatment are those showing (1) abnormal retinal correspondence on all tests in addition to a history of long standing heterotropia; (2) absence of potential sensory fusional ability, especially if it is combined with lack of suppression; (3) absence of motor fusion (the diplopic images are joined only by

exact prismatic correction, amplitudes of fusion are nil because of the absence of vergence responses); (4) alternating suppression in heterotropia of long duration; (5) constant heterotropia existing throughout childhood, with no treatment prior to the fifth or sixth year of life.

The last of the above points supports the findings of Chavasse,[2] who concluded that fusion is developed during the first five years of life and is dependent on the correct conditioning of the sensory and motor reflexes of which binocular single vision is comprised. Without some development of binocular vision during the first five years, orthoptic treatment is useless, since unfortunately orthoptics cannot produce fusion when it has never existed. However, if there is potential fusion, orthoptics can be expected to eradicate any abnormal adaptation provided it has not become unconditional or fixed.

Having stated the limitation of orthoptics, an outline is presented of the therapeutic techniques applicable to those cases with a favorable prognosis.

METHODS OF TREATMENT

The first aim is to overcome suppression, thus permitting an active normal retinal correspondence. This is closely followed by the development of fusional amplitudes. Suppression may be treated by one or more methods, depending on the cooperation of the patient. Included among these methods are exercises using the major amblyoscope. There are many exercises described in the literature, for use on the amblyoscope, including flashing, bikinetic stimulation and macular massage. The treatment techniques described by Mayou,[4] Walraven,[9] and Tibbs,[7] utilize foveal targets from the outset in preference to macular or paramacular sized targets.

Diplopia with correct localization of the images is taught by using a light as a fixation target, and colored filters over the eyes. This technique of teaching diplopia has been described often in the literature, and recently in detail by Woodward.[10]

Other antisuppression exercises utilize the cheiroscope, tracing, and fine visual tasks with the dominant eye occluded. A red filter worn over the dominant eye in everyday life may be employed to advantage in small angle deviations without anomalous correspondence. It should not be used unless there is normal retinal correspondence. The patient is instructed to work with colors, such as making patterns with colored beads and crayons. The principle used is that if color vision is excluded from the dominant eye while form vision is retained, the suppressing eye alone is able to determine color. This stimulates a diplopia and, in turn, a fusional vergence movement to join the images.

Once the patient is able to fuse in the primary positions of gaze, physiological diplopia is taught in order for him to appreciate normal binocular vision. Physiological diplopia is usually suppressed in the everyday use of binocular vision by most people. Its experience by nonsquinters is not necessary for a functional binocular vision, but it is of considerable importance to the individual who has had heterotropia.

Framing is an exercise to be used following the awareness of physiological diplopia. A game is made out of trying to "frame" certain specified

objects. A pencil is held in front of the nose between the eyes and object of regard. The diplopic images of the pencil seen by the patient represent the sides of a picture frame. The patient is instructed to frame, first large targets and then smaller ones. The smaller the target, the greater the area over which suppression is being eliminated.

Exercises to Correct Abnormal Retinal Correspondence

Once anomalous correspondence has been diagnosed, whether as a relatively stable condition showing a definite subjective angle on the amblyoscope, or as a "crossing" false, the patient wears a total occlusion. The dominant eye is kept occluded if the vision in the deviated eye is subnormal. This is a passive form of treatment to prevent any additional abnormal binocular cooperation. The only time during waking hours that the occlusion is removed is while binocular stimulation is being employed on a haploscopic instrument. There are many techniques described in the literature, including the "crossing" technique already mentioned. The latter may be used as a homework exercise on the binocular trainer.[8] The mother of the child is shown where the images must cross on the instrument and where superimposition should be attempted. She is told not to let the child move the target over the areas which could be interpreted as "false," otherwise more harm than good will be done. As correct retinal correspondence comes into play, fusion targets are substituted until fusion can be maintained at the correct angle.

At the present time, exercises to correct anomalous correspondence are limited to the use of haploscopic instruments.

Methods of Stimulating Fusion

In constant heterotropias requiring surgical correction, the only method for developing fusion amplitudes lies in the use of haploscopic instruments. At first, peripheral fusion targets are used, since they are more easily fused than the macular or foveal targets. They should be fused at the objective angle of deviation, and from this point an effort is made to increase the divergence and convergence amplitudes.

In the case of intermittent esotropias or exotropias, or any deviation amenable to nonsurgical treatment alone, other methods of stimulating fusion such as the use of diisopropyl fluorophosphate (DFP) and red filter worn over the dominant eye can be used. DFP may be used either in esotropias with a small accommodative element or in small tonic residual esotropic deviations following surgical correction. It can also be used in variable innervational deviations of nonspecific etiology, and in the adaptive type of blindspot syndromes. DFP is helpful in most of these cases, as it lessens the degree of deviation sufficiently to provoke a fusional movement converting the esotropia to an esophoria. The red filter worn over the dominant eye (alternating deviations excepted) provides a stimulus to fusion in making suppression difficult. Diplopia is more readily appreciated with two images of different colors. The DFP has a two-fold effect. Its first effect is through direct activation of the peripheral accommodation mechanism, thus avoiding any excess convergence associated with a central accommodation. Secondly, by miosis, providing more sharply defined retinal images within a slightly reduced visual field.

The exercises for physiological diplopia already described as anti-sup-

pression exercises, may also be used to improve the range of fusion. Physiological diplopia is taught within the patient's range of binocular vision. In looking from a relatively far target to a nearer target, the patient makes a fusional convergence movement, and in looking from the near target to the farther target, he makes a fusional divergence movement. The range of this vergence movement must include only his area of binocular vision. For young children, it is possible to use this exercise as a means of stimulating the fusional vergence reflexes (motor fusion) without the subjective appreciation of the physiologically double images. This abstract concept is not easily explained to small children. The observer giving the exercise must then judge from the position of the corneal light reflexes whether or not an accurate binocular adjustment is being made.

Prism exercises may be used to increase absolute convergence and divergence. Loose prisms or the Berens prism bar are used, together with a fixation light at the desired working distance. The distance of the light is determined by the status of the patient's fusional range. Training begins using the easiest distance of fixation, whether it be near or far. To increase convergence, base-out prisms are used. If it is desired to increase convergence for distance fixation, the patient starts a few feet from the light with a base-out prism held in front of his eye, through which he maintains fusion on the light. Holding a flashlight or pencil in front of his nose, so that he is aware of physiological diplopia, he walks back from the light. He should be aware of doubling of the pencil when fixing the light. When he is able to maintain fusion with this prism at twenty feet, he then tries with a stronger prism. Providing his amplitude of convergence is increasing satisfactorily, he may then remain at twenty feet and spontaneously try to fuse the prisms with which he has already recessed. Another helpful way of encouraging the convergence through the base-out prism at the distance of twenty feet is to ask the patient to look first at a pencil or target held in front of his nose, and then back at the light. Absolute divergence is trained in the same way, though not to nearly the same extent, by using base-in prisms.

A relative divergence and convergence exercise, similar to the one just mentioned, involves using base-in or base-out prisms with a target requiring accommodation substituting for the fixation light. In young children small pictures or numbers may be used instead of Snellen letters. The use of physiological diplopia, and also a red filter over one eye, is necessary if suppression is suspected. The patient may have good absolute fusional vergences and appreciate spontaneous diplopia of the light when fusion fails, yet be unable to find diplopia on an accommodative target. To ensure against such suppression, it is wise to use the red filter over the dominant eye and employ red accommodative fixation targets. In this way, the patient can easily recognize suppression in the disappearance of the red symbols he is viewing.

Relative vergences may also be trained by bar reading. The exercise of bar reading has been in use for a long time, and the principle was recently incorporated into a useful homework instrument, the Physiological Diplopia Reader.[8] This instrument has been designed so that the bar can be adjusted from a position of wide separation of the physiologic diplopic images down to a small and

exacting separation, where bifoveal fixation must be maintained. It is particularly valuable as a homework instrument, because the techniques for its use can be easily taught to the parent. The progress of the child can be determined objectively on this instrument, whereas in using the stereoscope one must rely on the subjective responses of the patient.

Dissociation Exercises

To teach dissociation of accommodation from convergence, the relative fusional divergence has to be increased. This may occur passively over a period of time if the degree of hyperopia reduces. If there is no actual decrease in the hyperopia, then control of the deviation to provide clear binocular single vision without correcting lenses has to be taught. The patient is first shown the difference between crossed eyes with double vision (while accommodating) and straight eyes with blurred vision (accommodation relaxed). Then from the vantage point of clear single binocular vision with correcting lenses, exercises are given to maintain clear single vision as the correction is gradually reduced. The correction is reduced by using fitover lenses starting with −0.50 diopter spheres. When this first step is accomplished, the strength of the fitover lenses is increased in one half diopter increments until the correction is neutralized. In order to compensate for the reduction in the lenses, the patient has to exert positive accommodation and relative fusional divergence. His ability to do this is judged from his progress on such exercises as framing, bar reading, and in the use of the Physiological Diplopia Reader. With the successful use of these exercises, complete dissociation may be accomplished. However, if the positive accommodation is inadequate to the demand, DFP may be used in conjunction with the exercises to stimulate accommodation without convergence.

The success of the orthoptist in using these exercises will depend on her ability to make the treatment interesting as well as challenging to the patient. A good result cannot be expected if the patient is bored. The treatment cannot be long and drawn out, since the attention span of a child is short, and it is with small children that the orthoptist is primarily concerned. To shorten the period of treatment, it is necessary to have good parental cooperation, which requires an explanation of the process of binocular vision in terms that can be understood by the layman. With the cooperation and understanding of the parent, much of the treatment can be accomplished by the use of home exercises which can be evaluated objectively.

The types of therapy outlined are now related to specific diagnoses, and illustrative case histories are presented.

1. *Constant Esotropias and Exotropias*

In general these tropias require surgical correction, but wherever indicated and whenever possible, preoperative orthoptics may be attempted to establish normal retinal correspondence and fusion. This may be achieved by training on the amblyoscope, by diplopia exercises, and by home exercises on the binocular trainer. Postoperatively, treatment may be continued for the control of any small residual deviation.

2. *The Blindspot Syndrome Adaptation*

The esotropias falling into this classification may or may not require surgical correction. Nonsurgical treatment to correct the deviation should be attempted first, except in cases of long standing in which the deviation is apparently mechanical. It has been observed that a few of the esotropias falling into this classification can be corrected by nonsurgical means.

The etiology of these cases deserves consideration. Chavasse[2] has stated that a sensory anomaly alone may cause a heterotropia. The sensory dissociation of the two eyes may liberate a pre-existing heterophoria, resulting in a concomitant deviation, since the ocular motor fixation reflexes are intact. In consequence, the deviation is both sensory and motor. The sensory obstacle may be a slight one, such as a small or moderate amount of hyperopia. If diplopia occurs, a purposive deviation might take place to alleviate the diplopia. That is, instead of suppression occurring immediately, the deviation may increase. If it increases to twenty-five or thirty diopters, the need for suppression of the diplopic image of direct visual attention becomes unnecessary, since this now falls within the area of the blindspot.

Some children have more difficulty than others in coordinating their motor activities. Some children exhibit difficulty in the progressive coordination of sensorial developments and motor responses implicit in the process of learning. This merely serves to emphasize the urgency of immediate and adequate treatment, because if the deviation is caught in the beginning stages it is possible to restore binocular vision by nonsurgical means; whereas, the longer the duration of the deviation, the more certain it is that surgical intervention will be required to correct the inevitable secondary motor correspondences.

In the esotropias of twenty-five to thirty diopters, the primary obstacle may be motor, in which case surgical correction is indicated. If the primary obstacle is sensory and the duration is not so long that the child has acquired secondary motor correspondences, therapy may well be nonsurgical. Alleviation of the sensory obstacle should be made, either through correction of any refractive error or by the use of DFP and the red filter, along with antisuppression and fusion exercises. If slight amblyopia is present, it is preferable to avoid the use of total occlusion, since this merely serves to delay the stimulation of any binocular response and further augments a separatist policy for seeing. It has been observed that in the majority of cases of recent origin, DFP and the red filter cause an alignment of the visual axes. As the fusion amplitudes increase with training, the DFP is tapered out. But if a large esophoria with reversion to an occasional esotropia persists, then surgical intervention may eventually be necessary for a good result.

CASE HISTORY—LYNN

Age at treatment, 4.5 years. Duration of squint, one month
Cycloplegic refraction:
+2.50 D. Sph O.U.
Manifest Hyperopia:
+1.50 D. Sph O.U.
Diagnosis:
Right esotropia; blindspot degree
Prism cover test:
ET 25△
ET′ 20△
Sensory findings:
Troposcope: Simultaneous macular perception
Small amplitudes of peripheral fusion, with some right suppression

Lancaster screen:
On blindspot
Treatment:
DFP and the red filter on the left eye. Orthoptics, eight office visits and home exercises
Results nine months following treatment:
Prism Cover Test: E 16-18△
E′ 16△
Troposcope: Good amplitudes of macular fusion
Absolute and relative prism vergences normal
Comment:
DFP has been used occasionally during the past nine months. Patient still reporting every three to six months for observation, because of the degree of esophoria

3. *Accommodative Esotropia*

First treatment may be necessary to ensure a comfortable range of binocular single vision with correcting lenses. Providing there is stable binocular vision with glasses, then treatment by dissociation exercises may be attempted; but only with due consideration of the refractive error, and the expected cooperation of the patient. It should be evident that in cases of high hyperopia, dissociation exercises are of limited benefit. The binocular visual acuity cannot be developed to a level better than that of the unaided visual acuity in the most ametropic eye. The aim should be for comfortable binocular single vision with the weakest correction, or without glasses wherever possible.

CASE HISTORY—GARY

Glasses given at age 5 years. Duration of esotropia, one month
Dissociation exercises at age 7 years
Cycloplegic refraction:
O.U. +5.50 +0.50 x 95
Glasses:
O.U. +4.50 +0.50 x 95
Diagnosis:
Fully accommodative right esotropia
Sensory findings:
Normal retinal correspondence and fusion
Gross stereopsis to fly
Treatment:
Dissociation exercises in 10 office visits and home exercises
Result six months after discontinuing use of glasses:
Prism cover test: E 12△ on 20/30
E′ 16△
Absolute prism convergence at 20′ = 25△
Absolute prism divergence at 20′ = 2△
Relative prism convergence at 33 cm. = 20(18)
Relative prism divergence at 33 cm. = 16(10)
Amplitude of relative fusional divergence with −2.00 spheres = E′ 25△ on 20/30
Near Wirt stereotest: 50 per cent

4. *Abnormal AC/A Ratio*

Orthoptic treatment is directed towards controlled accommodation with inhibition of any excessive convergence. DFP or bifocals are used in conjunction with orthoptics. The same dissociation exercises to increase relative fusional divergence are employed as in the fully accommodative esotropia, except that they are applied to the reading distance only. As in the case of some accommodative esotropias, it is not always possible to correct an abnormal AC/A (accommodative convergence to accommodation) ratio, even after a reasonable trial of DFP and dissociation exercises in order to dispense with bifocals. In these cases a near reading add is used indefinitely. This happens when either the positive relative accommodation is inadequate due to an accommodative anomaly, or when the relative fusional divergence fails to increase.

CASE HISTORY—DOUGLAS

Age at treatment, 12 years. Duration of near esotropia not known
Cycloplegic refraction:
+0.25 D. Sph O.U.
Diagnosis:
Esophoria with abnormal AC/A ratio
Prism cover test:
E 5△
ET′ 14△

E′ 5△ with add +3.00
Sensory findings:
Good amplitudes of foveal fusion
Diplopia at near
Stereopsis to fly with a +3.00
Treatment:
DFP, four office treatments and home exercises
Result:
Three months after discontinuing DFP and orthoptic exercises
Prism cover test: E 4△
E′ 8△
Absolute prism divergence at 20 feet = 4△
Absolute prism convergence at 20 feet = 18△
Relative prism divergence at 33 cm. = 8△(2)
Relative prism convergence at 33 cm. = 20△(16)
Amplitude of relative fusional divergence: with −1.00 D. Sph = E′ 12 on 20/30

5. *Intermittent Exotropias*

Only the intermittent exotropias of small divergent degree do not require surgical correction. In deviations of twenty diopters or more, surgical intervention is almost always required to attain comfortable and consistent binocular vision. Yet, in nearly all cases of intermittent exotropia, whether requiring surgical treatment or not, orthoptic treatment has a definite place and value. This statement may be questioned, in view of those exodeviations which despite a good surgical correction and adequate orthoptic treatment, continue to manifest an occasional exotropia. This is said to occur when the patient is daydreaming. Apparently loss of conscious visual attention produces an exotropia that is not unpleasant to the patient, inasmuch as a conscious control has already been taught. This phenomenon occurs in deviations as small as eight diopters. The explanation must lie in the etiology of the condition, which is not as yet fully understood. However, these cases are in the minority, and the over-all satisfactory results justify close attention to the improvement of the sensory binocular mechanism.

A conscious control of the deviation is taught through recognition of diplopia in the exotropic phase. Antisuppression exercises to elicit correct diplopia are used. It is not uncommon to find anomalous correspondence or marked alternating inhibition in the exotropic phase of the deviation in cases of long standing, which makes treatment laborious. Quicker results are obtained in these cases if surgical intervention precedes orthoptic treatment. The suppression areas then undergo a change relative to the motor alignment of the visual axes. This makes it easier to establish a correct diplopia. Fusion follows through stimulation of convergence, since it has been preserved in the exophoric phase of the deviation. Also, convergence is more readily trained than divergence, since the amplitude of convergence exceeds by far the amplitude of divergence in the normal subject.

It is, however, not sufficient merely to train absolute convergence. This error is sometimes made, and the patient has a blurred uncomfortable binocular vision, due to excessive accommodative convergence. The emphasis should rather be placed on the relative convergence, and a controlled relative divergence. Finally, in order to boost the reflex convergence, voluntary convergence is taught by the use of stereograms. These stereograms require controlled voluntary convergence and a fixed degree of accommodation.

CASE HISTORY—JEAN

Age at treatment, 8 years. Duration of squint said to be four years
Cycloplegic refraction:
O.D. −0.75
O.S. −0.62 −0.25 x 180

Diagnosis:
Right exotropia with small V syndrome, associated with acquired myopia
Prism cover test without correction:
XT 30△ Lht 5△ fixing O.D.
XT 25△ Rht 5△ fixing O.S.
X(t)′ 25△
Sensory findings:
Red/green diplopia test: Marked alternating suppression to 25△ base in, homonymous diplopia with 30△ base in
Troposcope:
No subjective angle. Images reported as crossing correctly. Unable to elicit fusion with −3.00
Vision:
O.D. 20/50
O.S. 20/40 without correction
Treatment:
Correcting lenses for constant wear. Red filter O.S. 11 orthoptic treatments and home exercises
Result one year after discontinuing treatment:
Vision: O.D. = 20/20− O.S. = 20/15− with correction
Prism cover test: X25△ with good binocular recovery on 20/30; with correction, X′ 18△
Near point of convergence: 3 cm.
Relative prism divergence at 20′ = 16△ (12)
Relative prism convergence at 20′ = 14△ (8)
Relative prism divergence at 33 cm. = 14△(12)
Relative prism convergence at 33 cm. = 28△(24)
Near Wirt stereotest = 85 per cent
Comment: Mother of the patient reports an excellent control of the deviation. Although the exophoria at distance exceeds 20△, the ophthalmologist in charge of the case does not advise surgery, as the myopia may increase.

6. *Small-angle Esotropias with Anomalous Correspondence*

In the small-angle esotropias, the anomalous correspondence is invariably harmonious and stable. Often peripheral fusion is present, though the amplitudes are poor and unstable. Cosmetically there is no problem, and the patient is usually asymptomatic on account of the good sensorial adaptation to the deviation. The use of orthoptics to acquire a functional result, in my experience, is rarely successful. The poor prognosis is due to late recognition of the deviation; usually because the parents have failed to observe anything wrong with the child's eyes, and examination is delayed until the condition is detected by a routine school examination. The stable anomalous correspondence in itself would indicate a sensory adaptation acquired at a plastic and, therefore, early age.

CASE HISTORY—MARGARET

Age at treatment, 5 years. Duration of squint said to be 3 years
Cycloplegic refraction:
O.D. +0.50 +0.50 x 105
O.S. +0.25 +1.25 x 75
Diagnosis:
Small angle left esotropia with left amblyopia
Vision O.S. 20/100
Sensory findings:
Troposcope: Objective angle +10△
Attempted a subjective angle but not reliable due to vision at +5△
Treatment:
Total occlusion O.D.
Glasses
DFP
Orthoptic treatments and home exercises
Result:
Vision O.S. with correction 20/30
Prism cover test: ET 18 with correction
ET′ 20
Troposcope: Objective angle, +18; subjective angle, +3 with simultaneous perception slides
Small amplitudes of peripheral fusion
Cosmetic

7. *So-called 'Fixation Disparities' or Esophorias with Incomplete Recovery to Bifoveal Fixation*

An incomplete recovery to bifoveal fixation, as measured with a prism over the eye with the "shift" was described in a previous paper.[5] A slight residual esotropia of one to five diopters apparently need not create any significant obstacle to binocular

single vision. With the present methods of testing, it is not possible in most cases to detect any anomalous correspondence. Simultaneous foveal perception is the rule, with good potential fusion, and stereopsis. The reason for the "fixation disparities," so-called for want of a better description, is difficult to understand, particularly when normal vision can be recorded in the eye with the shift. Inasmuch as stable binocular vision can be maintained despite the shift, it has been our practice to ignore it, and to concentrate on developing good fusional reserves. Perhaps when the etiology of this condition has been discovered or when our methods of testing the sensory correspondences are further refined, its occurrence might be prevented or cured.

In conclusion, a plea is made for the early recognition and treatment of the deviation. From a statistical analysis reported in a previous paper,[5] which gave the results of 140 cases of heterotropia treated before the child was four years of age, 69 per cent were functional. A significant finding not reported at the time was the average duration of the deviation. In cases in which functional results were obtained, the average duration of the squint prior to treatment was 12.8 months; in those with a cosmetic result, it was 16.1 months. It would seem that despite lack of control cases, it is not always good to advise the strabismic patient to postpone treatment.

SUMMARY

The clinical tests and findings in the diagnosis of the sensory anomalies have been reviewed because of their importance in the selection of cases suitable for orthoptic treatment.

Case histories have been used to illustrate the value of proper orthoptic treatment in the management of the various sensory anomalies.

The current methods of orthoptic treatment related to suppression, abnormal retinal correspondence, fusion amplitudes, and dissociation of accommodation from convergence have been presented. The limitations of orthoptics have been mentioned in the hope that orthoptics will not be employed as a panacea.

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Symposium: The Nonsurgical Treatment of Strabismus

THE MANAGEMENT OF THE DEVIATION

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THE management of defective visual acuity and the sensory anomalies have just been discussed. Still to be considered are the anomalies of the accommodation-convergence relationship. Our nonsurgical weapons are (1) the proper correction of the refractive error with glasses and (2) the use of miotics. This assumes that the deviations are not caused either by intraocular abnormalities or by mechanical or innervational factors. The ophthalmologist and orthoptist should aim for functional improvement in the treatment of heterotropia in children. Scobee[13] stated that 30 to 40 per cent of all patients with heterotropia could be cured by nonsurgical measures. A number of articles have been written recently concerning this general subject.[4-7,12,14-17]

REFRACTIVE CORRECTIONS

The most important factor in determining the refractive error in children is to obtain complete cycloplegia. During the past few years the results obtained with cyclogyl and homatropine convinced us that these drugs were adequate cycloplegics when one drop of 1 per cent cyclogyl, followed by a drop of 5 per cent homatropine was used. Retinoscopy was performed after thirty to forty-five minutes. Lebensohn[10] states that none of the newer synthetic drugs approach atropine in power and duration. Scobee was most emphatic in his statement that the only way to obtain adequate cycloplegia was with the use of atropine applied three times a day for three days prior to the examination. We have found that atropine is the drug that will most adequately paralyze the ciliary muscle. Since most patients with heterotropia are of preschool age, the ophthalmologist must rely entirely on retinoscopy for the determination of the refractive error. This makes complete cycloplegia of paramount importance.

In an attempt to compare the cycloplegic effect of cyclogyl-homatropine drops with the effect obtained with atropine ointment, we did cycloplegic retinoscopy on 27 children with heterotropia, ranging in age from 6 months to 6.5 years. First, 1 per cent cyclogyl and then 5 per cent homatropine drops were instilled in the described manner and retinoscopy was performed. A few days later the application of 1 per cent atropine ointment was begun. It was applied three times a day for three days. Retinoscopy was then repeated. The retinoscopy after each cycloplegia was done by the same ophthalmologist. Hyperopia was estimated to be 2.3 diopters after cyclogyl-homatropine drops, and 3.3 diopters after using atropine ointment. In other words, atropine cycloplegia revealed an aver-

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age of one diopter more of hyperopia than was found after cyclogyl-homatropine refraction. These findings show the definite superiority of atropine.

We agree with Scobee that ophthalmic atropine ointment is preferable to the solution. In no instance has 1 per cent atropine ointment produced a generalized flushing of the skin. When used in drop form, however, the solution apparently runs down the tear duct and is absorbed. Generalized flushing of the skin and even nausea are not uncommon in such instances. This is not surprising when we realize that one drop of 1 per cent atropine solution contains 1:100 grain of atropine, which is four to five times the amount of atropine necessary to produce a systemic reaction in a child weighing fifty pounds. We use 1 per cent atropine ointment for all children up to 6 or 7 years of age who have heterotropia.

In checking retinoscopy every twelve hours on four children who had received 1 per cent atropine three times daily for three days, Lester[11] found that cycloplegia was almost complete after twenty-four hours. Not more than one-half diopter additional hyperopia was found on the second day, and in no instance was additional hyperopia uncovered on the third day.

Any astigmatism should be fully corrected by glasses regardless of the type of astigmatism or the direction of the deviation.

It is important to measure the angle of squint while the patient is under cycloplegia. If it is diminished, it is proof that accommodation is an etiologic factor. The degree of esotropia corrected by cycloplegia represents the accommodative convergence. Glasses or miotics can be expected to relieve only the excessive convergence caused by accommodation. Any residual convergent deviation is the nonaccommodative portion and will probably require surgical correction.

Occasionally in esotropia, the deviation under incomplete cycloplegia is found to be greater than before the cycloplegic was instilled. In this instance the patient is presumably trying to see more clearly and the excessive stimulation to accommodate leads to excessive convergence.

Esotropia is the most common type of strabismus, and the majority of these esotropes have an accommodative factor. Scobee stated that at least 80 per cent of patients with esotropia have an accommodative factor, and advised full atropine correction, even for small amounts of hyperopia.

Costenbader[6] advocates full hyperopic correction in children under the age of 6 years, or even overcorrection of one-half to 1 diopter in children under 4 years of age, because of the possible latent hyperopia. He tends to agree with Swan that the full latent hyperopia in patients cannot be brought out by the first cycloplegic refraction because of the anatomic adaptations of the ciliary muscle due to the hyperopia.

Correction of the refractive error is considered in relationship to the type of deviation present, and the child's age. If the child is able to cooperate in the "E" game, the manifest hyperopia can be recorded. If correction of the manifest hyperopia alone completely corrects the esotropia, we do not feel it necessary to give the full atropine correction. On the other hand, if immaturity of the child prevents adequate testing of the visual acuity and the estimation of the manifest hyperopia is unreliable,

then the atropine findings less 0.50 diopter sphere are routinely prescribed. Diisopropyl fluorophosphate (DFP) can be tried in an attempt to correct any residual esotropia. This will be described later.

Occasionally the full correction, when first prescribed, blurs the vision of the child and he may refuse to wear the glasses. In such instances the use of atropine ointment at bedtime, every two or three nights, may make the glasses acceptable.

Scobee advised that cycloplegic refraction be repeated every six months until the child has reached the age of 8 or 9, or oftener if there is an increase in the esotropia while he still wears the glasses. We agree with Alpert that the alert orthoptist can often sense a need for recheck, especially if there has been a change in visual acuity, or if occlusion fails to obtain a satisfactory improvement in vision.[4]

When the hyperopia decreases, the glasses produce blurred vision. This may result in secondary divergence of the visual axes through inhibition of accommodation and relaxation of convergence. When a reduction in the strength of his lenses is necessary, a minimal correction will indicate the amplitudes of positive relative accommodation and relative fusional divergence. Minus lenses are added one-half diopter at a time and the patient's clear single binocular vision is tested while he accommodates.

The minus lens which no longer permits clear single vision has reduced the relative divergence outside the amplitude of fusion. Sufficient plus correction to permit comfortable clear binocular vision should be prescribed. For example, if an esotropia with a +4.00 refractive error can hold straight while vision remains clear with +2.00, then +2.00 should be given.

Hyperopia and esotropia tend to occur in families. The following case history illustrates the value of doing a prophylactic refraction on the straight-eyed sibling in such a family.

Case A:

J. M., age 3
History:
Negative, straight eyes
Heredity: two sisters with esotropia
OD, 20/40; NVOD, 20/40
OS, 20/70; NVOS, 20/50
Cover test:
Latent convergence distance and near with good binocular recovery
Prism cover test:
E = 8
E′ = 16
Field measurements:

Left	E′ 16
Up	E′ 12
Right	E′ 18
Down	E′ 16

Versions:
Normal
Near point of convergence:
3 cm.
Absolute prism divergence:
4 to 6 diopters at 20 feet
Absolute prism convergence:
25 diopters at 20 feet
Relative prism divergence:
12 to 14 diopters at 33 cm.
Relative prism convergence:
28 diopters at 33 cm.
Major amblyoscope:
Simultaneous foveal perception at +25 diopters
Good amplitudes of peripheral fusion
Atropine refraction:
OD — +3.75 +1.25 x 15
OS — +5.25 +1.25 x 105
Give less +2.50
After wearing glasses six weeks:
OD — 20/30 with correction
OS — 20/30 with correction
Prism cover test:
E with correction = 4; E without correction = 10
E′ with correction = 8; E′ without correction = 20
Near point of convergence:
3 cm. Good fusion amplitudes with prism vergences on macular targets on troposcope

Unfortunately the old fashioned advice of letting the youngster outgrow his heterotropia is still occasionally given, even by pediatricians. If all patients could be seen by the ophthalmologist when the parents first notice the occasional deviation, which is most apparent when the youngster is tired, sleepy or ill, the majority of cases could be cured simply by wearing corrective lenses. The following case illustrates the important effect of immediate treatment after the onset of intermittent esotropia.

Case B:

D. L., age 2.5 years

History:
- Left eye turned in slightly three weeks ago. Father noted that child was unable to pick up small objects without first going to the right or left of an object
- Hereditary factor: Paternal uncle is also affected

Atropine refraction:
- OD = +3.50 +0.50 x 180
- OS = +5.75 +0.50 x 105

Cover test:
- Constant left esotropia distance and near

Prism cover test:
- ET = 30
- ET′ = 40 to 45

Field measurements:

Left	ET′ 35 (?LHT)
Up	ET′ 35
Right	ET′ 35
Down	ET′ 40

Versions:
- Appear concomitant

Near point of convergence:
- Unlimited; left eye overconvergence to nose

Major amblyoscope:
- Objective angle +40△

Measured with +2.50 right eye = ET 20△
+4.00 left eye = ET′ 20△

Vision tested by throwing dime 15 feet
OD = Fixation central
OS = Past points 4 inches to left

Treatment:
- Constant occlusion right eye for two weeks, followed by glasses and red filter on right lens
- OD = +3.50
- OS = +5.75

One month later:
- Preschool Allen pictures: OD = 10/40, OS = 10/40

Prism cover test:
- E = 6
- E′ = 8

Near point of convergence:
- 3 cm. Good vergence reflex

Early checking of visual acuity by the pediatrician is a desirable method of discovering and preventing strabismic amblyopia. This is a proper part of every routine physical examination of the young child. When a mother thinks she has seen an occasional deviation, the ophthalmologist should give the child a complete examination, including atropine cycloplegia.

The young patient whose esotropia is corrected at distance when he wears adequate correction, but manifests an esotropia at near, should be given a bifocal strong enough to eliminate the esotropia at near. This may necessitate using up to a +3.00 add. The bifocal should be large as advocated by Fonda[8] and extend up to the lower margin of the pupil so that the child is forced to use the bifocal for near vision.

As soon as binocular single vision is stabilized, the strength of the bifocals may be progressively reduced, and clear single binocular vision should be present at all times. Through dissociation exercises of accommodation and convergence, the patient may learn to hold his eyes straight without glasses.

When hyperopia is associated with exotropia, glasses are not indicated unless the hyperopia is extremely high. Then only the absolute hyperopia is corrected, that is, the part which cannot be overcome by accommodation. Such correction will give the best visual acuity and still allow the maximum accommodation with its stimulation to convergence.

When myopia is associated with exotropia, full myopic correction

should be given so that the patient must accommodate for near vision. This will stimulate convergence and tend to reduce the exotropia.

The use of prisms is usually not considered an effective method of correcting heterotropia. In our practice, we use them only in rare instances in which the deviation is extremely small. We prefer to treat the nonaccommodative component of the deviation by surgery.

There are two disadvantages in using base-in or base-out prisms for correction of exotropic and esotropic deviations: (1) they can only be used in small deviations, since large prisms are unsightly and present problems of optical aberrations; (2) "relieving" prisms, as they are sometimes described, tend to induce an increase in the original deviation.

However, we do find a diagnostic use in the temporary wearing of corrective base-in or base-out prisms. They are particularly useful in small nonaccommodative deviations in which the presence of stable fusion is questionable by other methods of instrumentation. Only the patients who can achieve binocular single vision through the use of such prisms may then be considered candidates for surgery, since alignment of the visual axes would indicate functional results. Vertical prisms are definitely indicated in small concomitant vertical deviations, if the horizontal alignment is good enough to permit fusion.

MIOTICS

Abraham[1] began using miotics in 1939, and observed that miosis and a measurable amount of spasm of accommodation were produced. He found that diisopropyl fluorophosphate (DFP)) was superior to eserine and pilocarpine, since its inhibiting action on cholinesterase is irreversible and hence more prolonged. He reasoned that the use of miotics stimulated peripheral accommodation at near as well as at distance. Thus, the need for central accommodation is reduced, decreasing the stimulus to convergence. In 1949 he reported 44 cases of esotropia treated with miotics, and in 1952 he reported 88 additional cases.[2] One hundred nine of these cases were periodic in type. Of these, 89 per cent were helped with the use of miotics. Of the 23 cases of the constant tropias, 11 cases, 47.8 per cent, were helped by miotics.

In 1954 Abraham[3] reported another series of 66 patients, 42 of whom had developed intra-epithelial iris pigment cysts at the pupil. In these cases he had been using DFP once or twice a day and the pupils were kept constantly miotic. He observed that cysts did not develop in active pupils. On omitting the miotic, the cysts "shriveled up like dried prunes" in most cases within three to four months.

Between January 1953, and September 1955, Knapp and Capobianco[9] used 0.025 per cent DFP ointment on 277 patients. They observed that practically every patient who had used DFP at nightly intervals for more than two months had developed pigment cysts in the pupils. Those patients who had used DFP every other night, or less frequently, had not developed iris cysts. They confirmed Abraham's observation that the cysts shriveled after the miotic was stopped. They feel that the chief factor in the production of the cysts is the fixed pupil, since cysts do not develop in active pupils. This indicates possible disturbance in the metabolism of the pigment epithelium when it is held in a constant position.

Whitwell and Preston[18] reported the use of 1 per cent pilocarpine drops instilled three times a day in convergent strabismus cases that had been surgically corrected for distance but still had a residual convergence for near. This routine was continued for four weeks, beginning on the second or third day after operation, and was combined with orthoptic training. They found good binocular vision with fusion, and stereopsis was necessary for successful results. These observations concur in general with those by Abraham, who strongly emphasized the necessity of equality in vision if one expects the miotic to have any effect on the strabismus. Knapp and Capobianco conclude that DFP is as effective as or better than glasses in correcting esotropia ranging from +2.00 to +4.50△, unless there is astigmatism of +1.50△ or more.

After using DFP on 2,000 strabismus patients, during the past five years we have made the following observations:

Indications and Uses of DFP

1. When glasses do not relieve all of the esotropia, DFP should be added in an attempt to correct the remaining deviation.

2. In very young children, DFP can be used as a substitute for glasses if the deviation is completely corrected by DFP. This is especially true in cases of esotropia of recent onset, when the desire for binocular single vision is easily stimulated.

3. For children who are too young for a measurement of the basic misalignment with glasses, DFP eliminates the accommodative convergence element so that only the nonaccommodative deviation remains.

4. In most cases DFP changes an abnormal accommodation/convergence ratio to a normal one. In many cases this remains normal when DFP is discontinued.

5. When suppression is broken in accommodative esotropia associated with a moderate refractive error, DFP usually assists the patient in obtaining clear single binocular vision without glasses.

6. The near point of accommodation is improved with the use of DFP when the near point of accommodation is remote. The remote near point of accommodation is due to hypoactivity of the accommodation mechanism and DFP stimulates the peripheral accommodative mechanism.

7. DFP is effective in cases of blind-spot syndrome esotropia of the purely adaptive type. The use of DFP often reduces the esotropia to a small esophoria when used in conjunction with a red filter worn over the dominant eye.

8. If after orthoptic exercises for accommodative esotropia, the amplitude of relative fusional divergence does not increase consistently with the amplitude of positive relative accommodation, DFP frequently permits a patient to retain clear single binocular vision without glasses.

9. In cases of small residual postoperative esotropias with good vergence reflexes, DFP is thought to be instrumental in converting the manifest deviation to an esophoria. Again, the DFP is used in conjunction with the red filter worn over the dominant eye.

10. A variable esotropia of undetermined etiology may straighten under DFP therapy.

11. When glasses do not fully correct the esotropia and a manifest check shows that binocular single vision can be achieved with more plus, then DFP may be used as an adjunct to avoid increasing correction.

Contraindications for Using DFP

1. In the case of a residual postoperative esotropia of fifteen to twenty diopters, when the vergence reflexes or the amplitudes of fusion are poor, DFP may trigger an exotropia.

2. Contraindicated as a substitute for glasses in high hyperopia.

3. Rare allergic reactions.

The Procedure for Using DFP

DFP 0.025 per cent ointment the size of a grain of rice is placed inside each lower lid at bedtime for two weeks. If there is improvement, this regimen should be continued for two more weeks; then the dosage should be reduced to every other night for one month. If the desired improvement is maintained, the DFP dosage is reduced to every third night for one month. Thereafter DFP may be used occasionally as necessary to maintain straight eyes, as during an illness, or when the temporary omission of glasses is desired.

The following case illustrates nonsurgical correction using bifocals, DFP, and orthoptics.

Case C:

F. J., age 5 years and 8 months

History:
Left eye was noted to turn intermittently, beginning at age 4
Hereditary factor: Mother's cousin was affected with strabismus
Previous treatment: Glasses and visual training by an optometrist

Cyclo:
OD = +2.75; glasses: +2.50 add +3.00
OS = +2.75
VOD with correction = 20/30
VOS with correction = 20/30
VOD without correction = 20/30
VOS without correction = 20/30
NVOD with correction = 20/20
NVOS with correction = 20/30

Prism cover test:
E with correction = 4 on 20/30
ET′ with correction = 35 on 20/30
ET without correction = 35
ET′ without correction = 45
With +3.00, E(T)′ = 8

Near point of convergence:
4 cm.; left eye overconvergent; diverges at 4 cm.

Near point of accommodation:
8 cm. right eye
12 cm. left eye

Field measurements:

Left	ET′ 50+
Up	ET′ 50
Right	ET′ 45
Down	ET′ 50

Major amblyoscope:
No subjective angle; left suppression on fusion targets

Diagnosis:
Accommodative left esotropia with abnormal A/C ratio

Treatment:
DFP and red filter right eye. Glasses were discontinued after using DFP for two months. Orthoptic training was given to teach physiological diplopia and bar reading

Two years later: DFP has been used on a very few occasions; one or two applications following a cold, or high temperature

Result:
VOD = 20/20
VOS = 20/20
Prism cover test: E = 2 on 20/30
E′ = 4 on 20/30
Near point of convergence: 5 cm.
Absolute prism divergence at distance: 2
Absolute prism convergence at distance: 18
Relative prism divergence at near: 16
Relative prism convergence at near: 24
Amplitude of relative fusional divergence with −3.00 = E′12 on 20/30
Near Wirt stereoscopic vision: 30 per cent
Manifest HM: OD = +0.50
OS = +0.50

TABLE I
THE NONSURGICAL TREATMENT OF 178 CONSECUTIVE CASES OF HETEROTROPIA

DIAGNOSIS	NUMBER OF CASES	GLASSES PER CENT	DFP		OCCLUSION PER CENT	RED FILTER PER CENT	ORTHOPTICS	
			PER CENT	AVERAGE NO. OF WEEKS			PER CENT	AVERAGE NO. OF VISITS
Accom. Et. with Abnormal A/C Ratio	45	53	89	13	15	73	91	10
Intermit. Xt.	43	16	—	—	14	16	100	7
Fully Accom. Et.	43	67	74	17	33	77	96	11
Accom. Nonaccom. Et.	18	67	72	21	56	72	89	8
Abnormal A/C Ratio	8	13	86	8	25	25	100	7
Small Angle Et. Nonaccom.	11	27	55	9	64	56	91	7
Accom. Nonaccom. with Abnormal A/C Ratio	11	73	100	15	55	82	100	14

TABLE II
THE RESULTS OF THE NONSURGICAL TREATMENT OF 143 CONSECUTIVE CASES OF HETEROTROPIA

DIAGNOSIS	NUMBER OF CASES	FUNCTIONAL CURES PER CENT	B.S.V. WITHOUT GLASSES	B.S.V. WITH GLASSES NOT BIFOCALS	B.S.V. WITH BIFOCALS	GROSS B.S.V. WITH FIXATION DISPARITY	NONFUNCTIONAL CURES SMALL ET. OR XT.
Accom. Et. with Abnormal A/C Ratio	32	81	35	19	15	31	19
Intermit. Xt.	39	100	77	18	—	5	—
Fully Accom. Et.	33	100	27	58	—	15	—
Accom. Nonaccom. Et.	13	46	—	33	—	67	54
Abnormal A/C Ratio	6	100	66	—	17	17	—
Small Angle Et. Nonaccom.	11	64	14	29	—	57	36
Accom. Nonaccom. with Abnormal A/C Ratio	9	78	14	—	14	72	22

STATISTICAL STUDY

Our statistical survey on 981 cases of consecutive heterotropias taken from the files of our orthoptic service showed that 178, or 19.2 per cent, were treated by nonsurgical methods only. One hundred forty-three of these cases had been dismissed from orthoptics and the results could be classified according to the degree of functional results. One hundred twenty-four of these cases, or 86 per cent, were classified as achieving some degree of functional cure. These 124 cases were also analyzed according to seven different types of diagnosis, treatment, and functional status as shown in tables I and II; DFP had been discontinued at least three months in the group showing binocular single vision without glasses. The best functional results were obtained in intermittent exotropia, abnormal A/C ratio, and fully accommodative esotropia; the poorest results were obtained in the group classified as accommodative-nonaccommodative esotropia.

Last year Simmons reported before the American Association of Orthoptic Technicians the results of surgical and nonsurgical treatment of a near ideal group of 140 cases. These cases were also taken from the files of our orthoptic service. In this series of cases of heterotropia, the patients received treatment between the ages of 2.5 and 4 years. In those patients who obtained functional results, 43 per cent received nonsurgical treatment only.

SUMMARY

The nonsurgical methods of dissociation of accommodation and convergence in their relationship to the correction of the deviations have been discussed. These methods include the use of glasses, miotics, and orthoptics. A survey of 981 consecutive cases of heterotropia showed that 19.2 per cent were treated by nonsurgical means and of these, 13 per cent achieved functional results.

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MONOFIXATIONAL PHORIA

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MONOFIXATIONAL phoria is that particular type of extraocular muscle imbalance in which the deviation is made partially latent by peripheral fusion but in which a small residual deviation of one fovea remains manifest—the image projected onto the deviating macular area being suppressed.

During the past decade interest has increased in eye deviations of small degree. Various subgroups make up the loosely defined small angle esodeviations and exodeviations, and heretofore have been classified as either phorias or tropias. We propose that there is a third entity comprising the small angle deviations which bridges the gap between phoria and tropia. We have called this entity *monofixational phoria.*

Monofixational phoria occurs either as a primary or secondary disorder. It is secondary if it represents the end stage, or type of cure, resulting from treatment of strabismus and/or anisometropia. It is our impression that the patient who had a constant strabismus for some time prior to adequate straightening by surgical intervention, glasses or miotics, regardless of whether orthoptics were used, is as likely to follow the pattern of monofixational phoria as he is to develop a phoria with bifixational habits. Anisometropia is an additional factor which increases the chance of monofixation rather than bifixation. In addition to these post-treated strabismic patients, which comprise the bulk of people with this syndrome, a few monofixational phoria patients have no antecedent history of strabismus nor significant anisometropia. We refer to cases of the latter type as primary; whereas those resulting from prior treatment for squint or anisometropia are the secondary monofixational phorias. Those of the primary type are rare, or at least much less common than those comprising the secondary syndrome.

For some reason not clear to us, the monofixational esophorias are much more prevalent than the monofixational exophorias. A vertical deviation amounting to a prism diopter or two may be associated with the horizontal monofixational phoria. In rare instances the monofixational habit is alternating in type; one fovea is used while the other is suppressed; then the roles of the foveas are reversed the next moment in regard to fixation and suppression. However, the majority of monofixational phorias do not alternate.

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PATHOPHYSIOLOGY

Bifixation is the intersection of the visual axes at the point of regard (fig. 1). The object of regard must be on

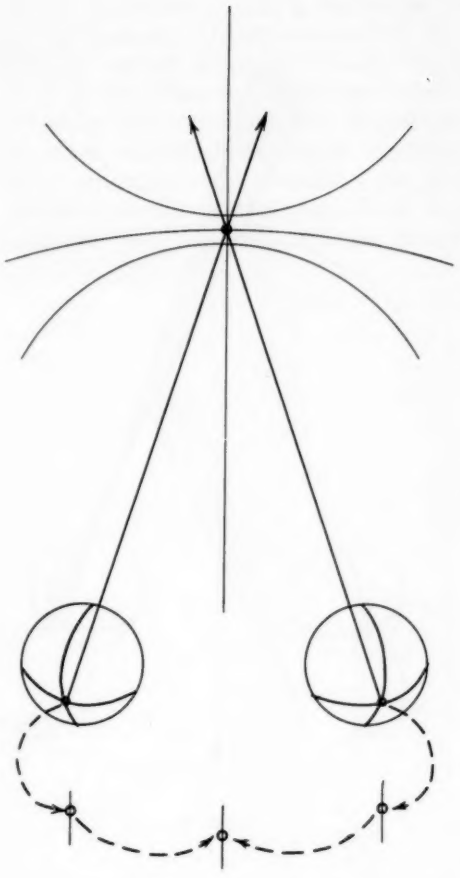

FIGURE 1.

the horopter at the intersection of the visual axes. In figure 1, the boundaries of Panum's fusional space are indicated on either side. Vertical and horizontal meridians of the retina passing through the fovea are shown, with the object of regard imaged on the foveas. The lower part of the diagram depicts the mental impression of the spatial localization of the object of regard in reference to the midline for each eye as well as the fused impression.

However, seldom is there such an exact ocular motor apparatus that absolute bifoveal fixation prevails. Rather, one eye is almost always deviated one way or another by a few minutes of arc so the visual axes do not exactly intersect the object of regard. In figure 2 we see the object of regard fixated by the left eye, while the ever so slight convergent deviation of the right eye causes its visual axis to miss the object of regard as it passes through Panum's fusional space. It should be noted that the object of regard is displaced in space beyond the horopter but within Panum's fusional space, and its image is located just nasally to the fovea of the right eye. Although the individual mental impressions of spatial localization differ, the composite impression is

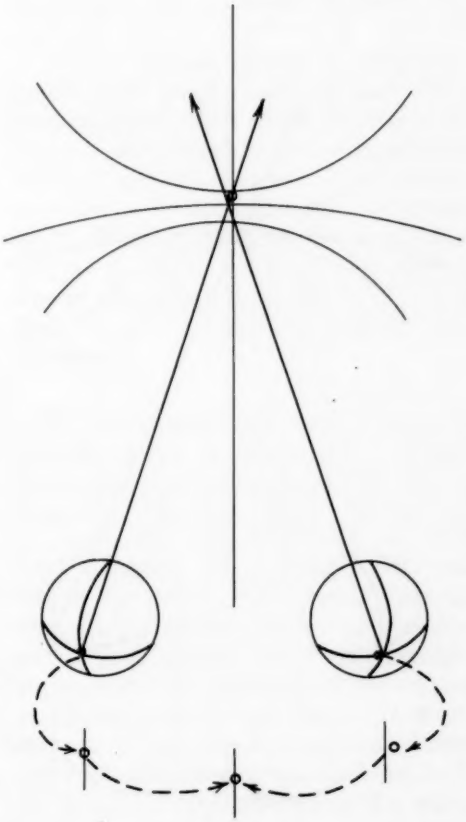

FIGURE 2.

the same as if there were bifixation. We know from Panum's fusional space studies that the horizontal deviation can be as large as six to ten minutes of arc before inciting diplopia.[8] This latitude of inexact bifoveal fixation within the framework of foveal fusion is referred to by Ogle[9] as *fixation disparity*. The terms *fusion disparity*[7] and *fusional disparity*[10] also have been used.

Small manifest deviations such as the esodeviation in figure 3 initially give rise to diplopia because the object of regard is beyond the outer limits of Panum's fusional space. In figure 4 a small area of suppression is shown in the right eye encompassing the image of the object of regard and macula. This functional scotoma is projected into space for the purpose of solving diplopia. Figure 5 demonstrates a peripheral object within Panum's fusional space being fused in spite of a small manifest deviation. It should be noted that the quantity of image disparity of the object of regard prevents fusion; however, the same quantity of disparity of peripheral images allows fusion. Hence, there is central suppression of the deviating eye in the presence of single binocular peripheral fusion.

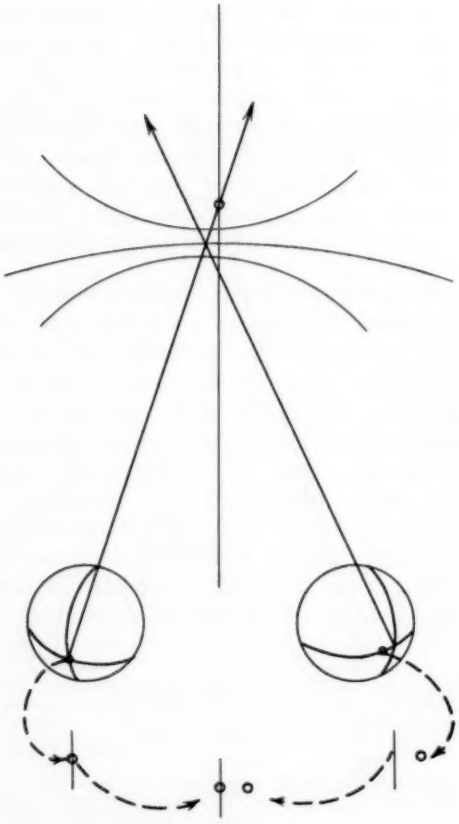

FIGURE 3.

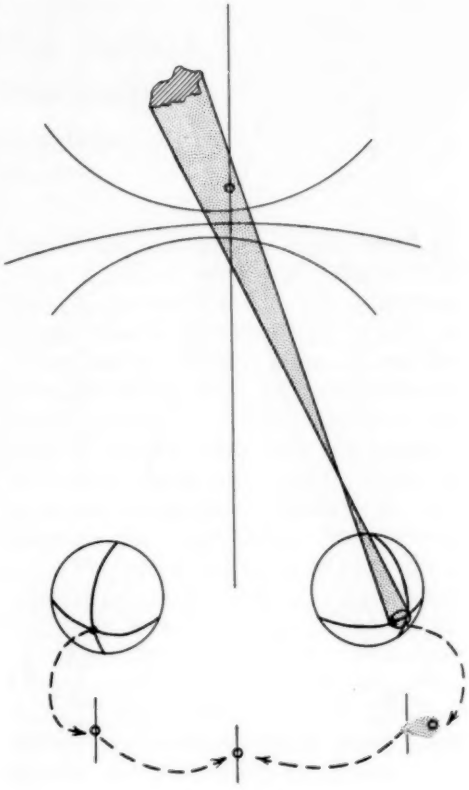

FIGURE 4.

In many of these cases of small manifest deviation, suspension of the peripheral fusion will evoke a greater

latent deviation which is too large to permit fusion. Upon removal of the obstacle which suspends fusion, there is a motor fusional response which partially reduces the latent deviation. A small manifest deviation persists; hence monofixation remains yet peripheral fusion is obtained. Had the fusional response reduced the latent

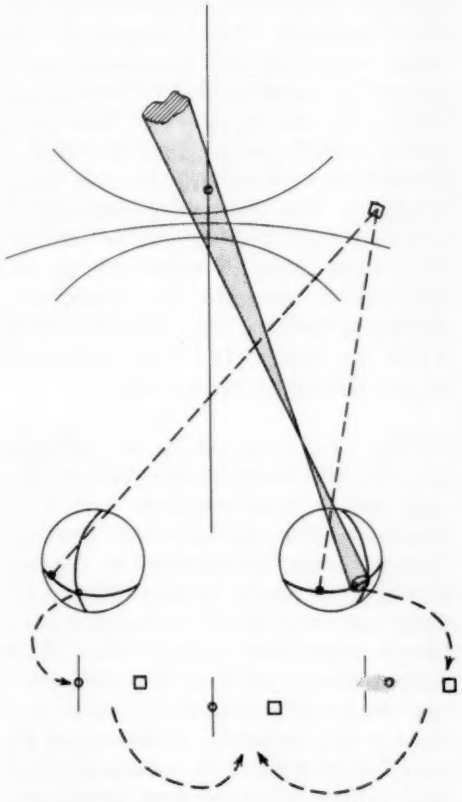

FIGURE 5.

deviation to zero, a bifixation phoria would have prevailed. We cannot explain why some patients undergoing fusional movement do not apply an insignificantly greater effort in order to achieve bifixation rather than be content with monofixation and the attendant sensorial adaptations within the deviating eye.

The quantity of deviation of the nonfixing fovea in monofixational phoria is much greater than six to ten minutes of arc. In fact, it is demonstrated by the monocular cover test to be between two and six prism diopters, or roughly one to three degrees, which is 60 to 180 minutes of arc. Therefore, monofixational phoria is something separate from fixation disparity, since a deviation of six to ten minutes of arc is impossible to detect with the cover test. It seems to us that Cashell[4] and Jampolsky[6] have described this same syndrome but have used the terms *fixation disparity* and *convergent fixation disparity*. Most probably other authors have had this same syndrome in mind as they described *retinal slip*,[2] *cortical slip*,[12] *flicker cases*,[3] *esophoria with fixation disparity*,[5] and *fusional disparity*.[10]

Monofixational phoria is easily confused with small angle tropia.[6] It is distinguished from tropia by the presence of peripheral fusion with normal retinal correspondence. The peripheral fusion is made possible supposedly by the capability of the peripheral retinas to fuse much greater retinal image disparity than the six to ten minutes of arc that the foveas can overcome.

We have previously stated that the macula of the deviating eye in monofixational phoria is suppressed during binocular viewing. This concept can be criticized, since Verhoeff[11] in 1935 first doubted the existence of true fusion in even orthophoric persons and suggested his theory of replacement in its stead. Adler[1] also creates some doubt that portions of the retinas populated solely by cones (foveas) have a fusion sense similar to those parts of the retinas which have rods. Be that as it may, there is still a wider area of suppression than the fovea

alone, since the amount of deviation in arc degrees is greater than foveal size. The suppression extends nasally by a small amount from the fovea in monofixational esophoria and temporally in exophoria. The depth of the suppression varies, but almost always it is more than facultative, since there is usually a slight amblyopia (obligatory suppression) of the deviating eye.

These patients have gross stereopsis. Apparently the misalignment of the two foveas is not so great as to preclude some appreciation of stereopsis although keen stereoscopic acuity depends upon bifixation.

DIAGNOSTIC METHODS

Visual Acuity

It is essential to determine the absolute maximal acuity of each eye, since most have acuities that approach 20/15 or better in the dominant eye and some will have close to 20/20 in the habitually nonfixing eye. Therefore, if the acuity is not checked beyond 20/20 in each eye, the relative difference between the two will not be apparent.

Cover Tests

Cover tests are done in accord with well established rules of controlling the accommodation, such as (1) demanding the fixation of small targets, preferably small Snellen letters or illiterate "E's," (2) the wearing of full ametropic correction, including bifocals if necessary, and (3) testing to be carried out at 6 meters and 33 centimeters. The cover tests are done in three different ways or steps. First, the single cover (cover-uncover) performed separately on each eye determines the presence or absence of a deviation as well as which is the habitually fixating eye. Keen observation is necessary to detect the small shift that occurs in the deviating eye as it establishes fixation.

The second step of cover testing determines the number of prism diopters the deviating eye shifts to obtain fixation after the dominant eye has been covered. To accomplish this, when covering the dominant eye a prism is simultaneously introduced before the deviating eye. The prism power which neutralizes the shift is termed the prism single cover measurement. The shift will generally be between two and six prism diopters. The measurement obtained in this manner is actually the amount of deviation present in everyday seeing while the patient is fusing peripherally yet fixating monocularly.

The prism single cover measurement is followed by the prism alternate cover measurement, which determines the amount of deviation present while the patient is deprived of the opportunity to fuse. More often than not the latter measurement is larger than the former. The difference between the two is a measure of the fusional divergence required to reduce the deviation to the point that peripheral fusion is obtained while still falling short of total eradication of the deviation needed for bifixation. The prism single cover test should be done routinely prior to the prism alternate cover test. It is not uncommon for the inexperienced examiner to misdiagnose a monofixational phoria as a tropia. The error is made when the patient is approached first with an alternate cover test; the 10 to 20 prism diopters brought out are mistakenly interpreted as indicating tropia. We have established the prac-

tice of recording the amounts of deviation found both on the prism single cover test and on the prism alternate cover test in that order. We have also found it convenient to designate the monofixational phoria by the letter *M* and the succeeding symbol, *E* or *X*, indicates the direction of the deviation, i.e., *eso* or *exo*. For example, in a case of monofixational esophoria the record might read ME 4-10, ME′ 4-14; and in monofixational exophoria, MX 3-9, MX′ 3-9. At a glance we know the amount of deviation being kept latent by fusional divergence. Some patients will show the same measurements in the prism single cover test as in the prism alternate cover test so that only one number will follow the proper monofixational phoria designation, but in such cases the deviation does not exceed six prism diopters.

Worth Lights

The ability to fuse Worth lights is tested at 6 meters and 33 centimeters. Normal room illumination is maintained, which enables use of peripheral fusion clues. A darkened room eliminates these clues; consequently, the deviation may increase and now cause the patient who reported fusion in a lighted room to report diplopia or suppression. Patients having this syndrome fuse the Worth lights in most instances, since this is a test for the presence of peripheral fusion.

Stereoscopic Acuity

We have found the Wirt Stereotest,* a test based on the polarized light principle, an efficient method of grading stereoscopic acuity. A small pointer may be given to the child to indicate his responses, thus obviating the problems that may occur as a result of his unfamiliarity with numbers. We score the patients according to the key provided with the test, using the decimal score. Patients with the monofixational phoria syndrome score poorly, usually ranging from 0.02 to 0.2. A good score—the average is approximately 0.8—is dependent upon bifixation.

Major Amblyoscope

The procedure on the amblyoscope is the same as for any other patient with normal retinal correspondence. There is a tendency with dissimilar targets to have more suppression within the nondominant eye. Naturally, the amplitudes of fusion are greater with larger fusion targets than with small ones. Patients with the primary monofixational phoria syndrome usually have diplopia at the end point of fusional amplitudes because no pattern or peripheral suppression has been established. However, those having the secondary syndrome tend to carry over the various degrees of suppression that existed prior to the eye being straightened unless specific antisuppression treatment has been carried out.

Binocular Perimetry

A small absolute scotoma corresponding to the macular area of the deviating eye can be plotted by employing binocular perimetry. One of us (M.M.P.) has found it handy to use a modified Strabismometer* designed to project a one-millimeter green target which is visualized by the deviating eye behind the green lens. In a room that has been darkened to eliminate peripheral fusion

*Copyright 1947 by S. Edgar Wirt, Ph.D.

*House of Vision, Chicago.

clues, the patient attempts to place the small green dot inside a slightly larger red ring which is visualized through a red lens by the fixating eye. The green dot invariably disappears just as the patient having this syndrome is about to locate it in what he considers to be the center of the red ring, whereas patients with bifixation visualize the green dot positioned within the ring. The disparity on the screen noted by the examiner is a measure of the phoria present. The suppression scotoma usually measures about three arc degrees and does not exist when monocular perimetric studies are carried out.

TREATMENT

Our experience with this syndrome leaves us with the impression that there is no therapeutic regimen capable of converting these patients to bifixation habits once monofixation has been established. Rather, the results have provided frustration for the ophthalmologist and orthoptist and wonder on the part of the parents at all the fuss, since the child's eyes appeared straight and he was free of symptoms. This is not to say that nothing should be done, but certainly an honest evaluation should be made of what can be done to benefit the patient.

Significant deviations, as determined by the alternate cover test, should be corrected surgically. Significant ametropia and anisometropia are treated with glasses. An abnormal accommodative convergence is treated with bifocals or anticholinesterase drops. Amblyopia is treated by occlusion. The technique is varied depending upon the severity of the amblyopia, the age of the child, and his school situation. In general occlusion is prescribed full time for preschoolers and part time for those of school age until adequate vision is obtained. Suitable home exercises may be given. Occlusion is continued until the acuity of the amblyopic eye is equal to that of the dominant eye or has reached its limit, which often is one to two lines below that of the dominant eye. At this point, occlusion for any child who is not able to maintain the new level is placed on a part time basis until the child is 8 years old. The patients who wear glasses are given a second pair in which the corrective lens for the dominant eye is replaced with an occluder lens.* This second pair of glasses is worn after school.

A larger area of suppression than the macular area of the deviating eye is often encountered in those children whose deviation was a frank tropia prior to its conversion to monofixational phoria by surgical correction or glasses. This is manifested clinically by observing how difficult it is for some patients to regain a range of two to six prism diopters of esodeviation after the alternate cover test has disrupted fusion. There is a delay of several seconds, and often a need for blinking and rolling of the eyes before the ten to twenty prism diopters of esotropia induced by the alternate cover test is reduced. During this period of esotropia, diplopia is not appreciated. Fatigue, toxic states, and peaks of emotions often convert the small deviations of the monofixational phoria type to definite tropias, and again, during the existence of the tropia there is no significant diplopia recognition. It is therefore reasoned that some degree of peripheral suppression must facultatively exist along with the more dense obligatory sup-

*American Optical Co., Southbridge, Mass.

pression of the deviating fovea. Treatment of the peripheral suppression is indicated. As the suppression is lessened, an attempt is made to increase the fusional amplitudes. Such methods as recession with red glass and prisms, work on the major amblyoscope, and use of a polaroid television trainer* are suggested.

SUMMARY

Monofixational phoria is a state of ocular imbalance in which single binocular vision is maintained by peripheral fusion, yet only one fovea is fixating while the other is deviated and suppressed. The combination of Panum's fusional space plus suppression of the macular area of the deviating eye explain how this syndrome is possible. We recognize the monofixational phoria to be extensive, occurring infrequently as a primary problem but developing in large numbers of patients treated for anisometropia and tropias, particularly the esotropias.

Although it is our desire in the treatment of strabismus to achieve single binocular vision secured with bifoveal fusion, we admit that it is not always obtainable. To attain for the patient everything except bifixation is not a result to be maligned. Such a patient enjoys good vision (even though the acuity is relatively less in the nonfixing eye), peripheral fusion and gross stereopsis.

*American Optical Co., Instrument Division, Buffalo, N. Y.

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PRELIMINARY REPORT ON USE OF DIISOPROPYL FLUOROPHOSPHATE (DFP) IN ALTERNATING ESOTROPIA

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MIOTICS have been used for many years in the treatment of accommodative squint. Javal mentioned the use of parasympathomimetic drugs, specifically pilocarpine, in the treatment of esotropia as early as 1896. The major use of miotics, however, has been in the case of accommodative esotropia. The purpose of this presentation is not to go into the theory of the relationship of miotics and squint, but to discuss certain other aspects of the use of miotics, diisopropyl fluorophosphate (DFP) in particular in its clinical application to orthoptics. We feel that DFP has an important place in treatment of accommodative strabismus, especially in those youngsters who for one reason or another are not able to tolerate a spectacle correction, or in youngsters whose parents are uncooperative because of what they feel is the cosmetic disability created by glasses, or in youngsters who are not expected to use their glasses during summer vacation and in whom DFP can maintain straight eyes. We also feel that DFP has another very important use in the treatment of the very young patient with nonaccommodative esotropia. There is a large group of children, mostly between the ages of 2.5 and 4 years with esotropia that is comitant, and with little or no measurable accommodative factor, who obviously need treatment. Throughout this discussion the term *accommodative* will be used in a strictly limited sense, referable to the refractive factor as a cause of strabismus, although there is little question at this point that the term *accommodative* in its general sense involves much more than purely refractive effects.

These youngsters with nonaccommodative esotropia are usually found to be suppressing. They are often either very uncooperative or too young to understand what is desired of them in the usual orthoptic techniques. The usual result is that the ophthalmologist or the orthoptist tends to temporize and wait until the child is a "little older" so that orthoptic training can be completed just prior to any possible contemplated surgery. Of course, by the time the child returns at 4.5 or 5 years of age, his suppression has become much deeper and requires subsequent orthoptic training of long duration to develop some element of fusion. We believe that DFP has a place in this circumstance.

Mention will first be made of some of the problems in the use of DFP. We have been using Floropryl or isoflurophate (0.025 per cent) in ointment form. This drug must be used with care and under careful supervision. It supposedly can cause retinal detachment, although this complication is extremely rare, and does not militate against its use.

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The first few applications may cause extreme discomfort to the child, headache, pain in the eyes, darkening of vision, redness and other such signs of ciliary spasm. For this reason it is best given at bedtime, as there is less discomfort. The symptoms usually disappear after the second or third application and do not recur. We have found the average optimum interval to be every two or three days. In some youngsters this can be extended to one week; in others more frequent applications are needed.

Iris cysts are frequent and are the usual accompaniment to the use of DFP. We feel slit lamp examination should be done at approximately two-week intervals. Further, the parent should be advised of the possibility of cysts and told that although these may look quite serious, they will regress on cessation of the drug. These cysts occur at the pupillary margin, often in clusters, and may achieve considerable size, even covering the entire pupil. When discovered, they often will not progress if the frequency of the DFP instillations is decreased. If they are found to be getting larger on cessation of the DFP, they will usually completely disappear within one or two weeks. Several youngsters who appeared to have poor miosis were, on further examination, found to have large cysts developing just under the pupillary margin, evidently preventing complete constriction of the pupil.

There follows a preliminary report on a small group of patients with comitant squint and with little or no accommodative factor, who were treated with DFP. This group was composed of nine children, ranging from the age of 3 to 4.5 years. They were all hyperopes, with correction ranging from +0.50 diopters to +3.75 diopters in each eye, but all had in common the fact that there was no change in their angle of deviation with or without glasses. The average visual acuity was 20/30 in each eye as determined by the E game. All were too young to use the usual orthoptic methods of training. All of them showed no fusion with alternate suppression. Their deviation on the prism and cover test varied from the smallest, 10 diopters at distance to 25 diopters at distance, and from 20 diopters at near to 50 diopters at near. In other words, the deviation was always less at distance than at near. All of these patients had variable alternating esotropia, a situation that can often be very difficult to work with. Strangely enough, eight of the nine preferred fixation with the right eye; the one who fixed with the left eye was uncooperative in everything else as well. All showed overaction of both inferior obliques except that one, who had an overaction of the right inferior oblique only. The procedure was to instill DFP (0.025 per cent) in each eye every other night. Each child returned for follow-up approximately once a week and had a slit lamp examination every other week. After the child had been started on the DFP, the following things were checked: appearance, any change in deviation on the prism and cover test, amplitude and peripheral fusion as determined by the polaroid housefly and troposcope with gross paramacular slides. I might mention here that we found the polaroid housefly to be a most useful test and one in which we could get most consistent answers in this age group. In addition to the DFP, the youngsters were put on antisuppression work at home with the stereoscope and red lens.

The first noticeable change was a gradual improvement in appearance despite the fact that pinpoint pupils

may tend to have the effect of making a deviation more noticeable. This change was first noticed as early as two months in some cases; in others it did not occur for six months. The average was four months. The improvement occurred first for distance measurements with still a big convergence factor present; gradually, there also occurred lessening of the deviation at near.

Five of the nine patients developed iris cysts, but in no case was it necessary to decrease the DFP sooner than three months from the starting date. Seven of the nine patients developed peripheral fusion as tested with the polaroid fly. Of the two patients who did not develop any peripheral fusion, one never developed good miosis and, because of an insurmountable language barrier, we were never certain that the DFP was being properly given. The other had other malfunction, including occlusion nystagmus and poor fixation of one eye. None were "cured" of their strabismus by DFP, and all either were subsequently referred for surgical correction or became old enough to switch over to standard orthoptic methods, with good results. The following cases are examples of the usual course:

Case 1

Gregg was 4 years old, with a variable alternating esotropia ranging from 12 to 30 diopters at distance and 28 to 35 diopters at near. His cycloplegic correction was +1.50 diopters in either eye. He was given a full correction with no alteration in the deviation. He was determined to have fusion but alternate suppression. He was placed on DFP at three-day intervals and in approximately three months developed brief fusion as checked with the polaroid housefly and troposcope. His appearance has improved and there was a moderate decrease in his angle of squint. He developed iris cysts approximately three months after the initiation of DFP therapy. Upon cessation of the medication there was good regression of the cysts. Surgical correction was decided on, and a bilateral recession of the medial recti was done. Postoperatively, it was found that 30 diopters of esophoria at distance had been reduced to 8 diopters, and 35 diopters of esotropia at near had been reduced to 15 diopters of esophoria. Subsequent orthoptic training has maintained an excellent result.

Case 2

Pamela was 4 years old when first seen. Her vision was 20/30 in each eye; on the prism and cover test her esotropia measured 20 diopters at distance and 35 diopters at near; she had no fusion and showed alternate suppression. Cycloplegic refraction showed +2.25 sphere in either eye with no improvement in deviation with glasses.

This child was rather uncooperative. She was very high-strung with a possible psychological problem. We were unable to use the usual orthoptic techniques in working with her, so it was decided to try her on DFP. She was started on 0.025 per cent DFP every other night. In two months' time, with the additional use of antisuppression homework, she had developed peripheral fusion using the polaroid housefly and troposcope. She was also developing several small iris cysts. The instillation period for DFP was lengthened to every third day with no subsequent increase in the size of the cysts. On examination three months after starting DFP, Pamela's esotropia had decreased from 20 to 12 diopters at distance, and from 35 to 20 diopters at near. She had good peripheral fusion and some macular fusion. She is still on DFP, though surgical correction is contemplated in the near future.

In conclusion, DFP in nonaccommodative alternating esotropia in very young or uncooperative children may be a very useful adjunct in achieving some measure of improvement in the angle of squint and in developing peripheral fusion. Especially in that group of highly variable alternating esotropes who are too young for either detailed orthoptic analysis or treatment. One of the useful aspects of the DFP treatment is that it seems of

help in more rapidly establishing a definite pattern of strabismus (the pattern is usually apparent within three to six months) and assists the ophthalmologist during the disconcerting period when he cannot be sure whether there is 5 diopters of esotropia or 35 diopters of esotropia. From our present use of DFP, though in a very small group of patients, we suspect that this drug may also prove to be of some value in encouraging the very young infant with a variable squint to develop some fusion and thus to avert the development of certain additional sensory anomalies, such as amblyopia ex anopsia and anomalous correspondence.

THE LANGUAGE OF BEHAVIOR

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CHILDREN communicate with us in many ways; in the obvious form of speech and in the more subtle form of behavior—a nonverbal communication. The child's behavior is not, from his viewpoint, necessarily a means of communication: The child behaves the way he does to solve a problem, to satisfy a need, to reach a goal. Sometimes this behavior is relatively easy to understand and tells us what is going on inside the child, what he fears, what he desires. But at other times, behavior is extremely difficult to interpret. If a child follows your instructions, but only to a minimal extent; makes no comments; shows no feelings, either negative or positive, he may be fearful or angry, but it is not easy for you to tell which emotion is preponderant. A more easily interpreted type of behavior is that of the blustering, cocky, "know-it-all" boy who strides into your office, apparently ready to take over the whole examination. As you "listen" carefully to his behavior, you hear the fear, the anxiety, which is underneath this exterior. As you "listen" to the exaggerated self-confidence, perhaps hear an incongruous lisp, note the fingernails bitten to the quick, you know the child is more frightened than angry.

Learning to "listen" to this behavior is an essential part of understanding children, and of working with them. In your work it is important for you to gain the child's cooperation, to motivate the child to attempt the repetitive and sometimes, to him, uninteresting exercises which will lead to a goal important to his future but which may mean little to him at the time. If you can understand what the child is saying by his behavior, then you may get clues as to how best to interest him, to motivate him. The most complex and frustrating situations are those in which the child may say he wishes to cooperate but on an unconscious level, he has a need to oppose or to fail. Parents complicate this picture even further; their needs and the meaning of the child's success or failure to them are factors which either help or hinder your efforts to help the child.

Thus, to work effectively with a youngster you need to know something about him, his needs, his fears, his hopes. The obvious approach would be to ask the child how he feels, what his behavior means, why he does what he does. But difficulties confront us when we attempt to rely on direct questioning as to motives and feelings. The child may not want to tell us, or he may not have the vocabulary to tell us how he feels. Vocabulary obviously varies with age and "feeling" words are among the last to be learned. The learning factor not only is dependent upon age but is also a reflection of the fact that parents teach children the names

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of objects but not how to identify their feelings. Also it is easier to learn the name of something you can see or touch than it is to identify verbally some abstract feeling. A third difficulty is more complex; the child often does not know why he behaves or feels in a certain way. How often have we said to a child in exasperation, "Why did you do it?"; only to be answered by the equally exasperating "I don't know." I do not deny that this often means "I don't want to tell you," but perhaps more often than we realize it means just what the child says—he does not know. I refer to a basic fact of behavior; not all motivation is conscious; we are not aware of the underlying reasons and causative factors behind much of our behavior. Which one of us has not been embarrassed when we have forgotten a person's name or forgotten an errand we were asked to do. If we take time to analyze the incident carefully, we often come up with the reason, "He reminds me of John Smith, whom I cannot stand," or "The request is an imposition."

Behavior is often difficult to understand, often does not seem to make sense. At times a particular child's behavior seems aimless or self-defeating because neither we nor the child knows what the real motivation is, what the child is actually trying to accomplish. This does not mean that if we only understood better, we would find all behavior to be effective and efficient, for it is not. For example, there is the child who wants friends very much, but who, because of his too great need and unconscious hostility, tries to dominate them, keep them only for himself, and thus loses them.

Many of the children who are brought to you must present very complex patterns of behavior. We are aware of the varied influence eye defects may have upon a child's concept of himself as well as how these defects may distort or disturb his perception of the world. The reverse is also true, emotional difficulties have their influence on vision. Each child who comes to you is unique. The defenses and the behavior presented vary in meaning with each child, his age, and his family relationship. That is, the meaning of specific behavior must be interpreted in terms of who, when, where and how. However, there are common meanings as well as individual meanings to the behaviors exhibited by the children who come to your offices. The types of behavior discussed below do not exhaust those you may see in your office, but they represent some of the more common patterns and defenses encountered.

The child who comes into your office full of anger and active resistance, lets you know what he really thinks of this particular visit and of the world in general. All too often he is the product of angry, punishing parents. They may well have, perhaps unconsciously, presented the visit to him as a punishment. They may have made the child feel that his visual difficulties are all his own fault, that he is to blame for the expense and bother and time the parents are having to expend on his eyes. While it is true that this behavior on the part of parents may call forth a withdrawal pattern in some children, many fight back. This is a more healthy reaction than withdrawal, but for the instant it is more difficult to handle in the office situation. Among the children who actively resist, there will be those who show no feeling but anger and resentment and opposition. For example, while we see this more often in boys, I recall one girl who calmly announced she would

have nothing to do with anything in the office, the visit was all her parents' idea, and she had no intention of pleasing them or me. Then there are others who present the same superficial aspect, but a little observation and "listening" will reveal that their anxiety, their fear, is close to the surface, as evidenced by the "know-it-all" boy mentioned earlier. The latter type will be quicker to respond to your interest and concern than the former.

There are other forms of resistance which may be harder to identify and, in a way, harder to deal with. Among these is the resistance shown by children who *appear to be* cooperative and interested. However, at a subconscious level they are resisting your efforts just as effectively as those who actively resist. It is difficult to identify this kind of hostility. These children have given up actively fighting the demands of those in authority, but they continue to be just as resistant as if they had screamed at you, "I won't!" These youngsters give lip service, and only that, to the desire to improve their vision or make any other changes. Their strong hostile feelings make it necessary for them to oppose the requests of others, even when such requests are for their own benefit. They cannot do so openly because the direct expression of hostility is too anxiety provoking, seems too dangerous. It is well to remind ourselves at this point that the child is often even less aware of what he is doing than we are of the meaning of his behavior.

The timid, withdrawn child must not be approached too abruptly. We must give him time to appraise the situation and to become aware that we respect his fears and his reticence. There are various reasons for this behavior, but it does mean a marked insecurity in relating to others. Conversation, particularly with a stranger, is difficult for these children. Their past experiences have made them fearful. While they are also hostile, the evident and obvious emotion is fear. The hostility does not as easily come to the fore except in a disguised form. They are too fearful of the consequences, the retribution which will be visited upon them, if they reveal their hostile feelings.

The anxious child has a strong component of fear in his make-up. This child often is constantly wiggling, constantly talking, playing with anything within reach. His overactivity is the clue to the many vague fears typical in the anxious child. He generally does not know just what he is afraid of, or his fears are all out of proportion to the reality he dreads. Some anxious children present a different exterior. They seem calmer, more at ease, but they have bodily complaints for which the doctor can find no physical basis. All of us have experienced a headache or stomach upset brought about, not by any physical cause, but by an emotional upset. Even a child, faced with emotional stress which he feels incapable of modifying, may sometimes unconsciously express his anxiety in the form of illness. This behavior or defense is particularly difficult to handle. Not only will you find it difficult to differentiate between illnesses with a physical cause and those of psychogenic origin, but you must also take into account the fact that illness has its own secondary rewards. That is, the child who is sick is usually the center of solicitous care, which is comforting even though it may not lessen his emotional problems.

Then there is the normal youngster who may, at times, exhibit one

or another of the above defensive behavior patterns but none to excess. He may get a stomach-ache just before going to the doctor; he may sometimes hurt himself to spite others; he may withdraw in a strange situation. All of these things he may do, but none exclusively or to excess.

Before we continue with a discussion of possible ways to cope with these various reactions, it would be worth our while to spend a few minutes on the role of the parents. They play a more important role during actual treatment than most of us realize. Certainly the parents' initial attitude will influence the child's, either positively or negatively, depending on their relationship to the child. There are angry, resentful parents whose children all too often, in response to parental anger, refuse to accept help, refuse to cooperate. To such a child, improvement would mean surrender, would mean pleasing those at whom he is angry. This relationship between parents and children is probably easier to understand than one in which the parent attempts to keep the child from growing up and thus away from them. This is not usually on a consicious level; nevertheless, the child feels guilty if he moves away from his mother. Growth in such a family situation is more difficult than in a normal one, for it involves relinquishing certain pleasures and comforts and at the same time arouses guilt feelings as well as fear. The child has, by his mother's overprotectiveness, come to see the world as a dangerous place and himself as quite incapable of facing it. There are parents who expect too much, whose standards are so high that their child feels incapable of attaining their goals for him. Therefore he stops trying to please them, for he is sure he can never satisfy them; and he is right, he cannot. Parental behavior is due to causes as obscure as those governing the behavior of their children. The unconscious unknown determinants of behavior are active at all ages and are difficult to control by good resolutions or by being told to feel or act differently. There is no simple, quick solution when you find these kinds of situations developed to a marked degree. You will find some of the relationships between parents and children so distorted that you will need to refer them for professional help with their emotional problems before they can profit from your specialized help.

There is no one successful way to react to these varied types of behavior or defense. However, there are some guideposts which may be helpful. We must realize that there will be children whose emotional disturbances are so great that, despite our best efforts, they will not respond. Foremost among the essential characteristics of a person who works with children is a good feeling towards people in general. This involves a respect for their individuality; warmth towards them as fellow human beings; and a willingness to see their defensive behavior, not meant primarily as something to hurt or thwart us, but as their previously learned protection against the environment and their own feelings. It is not possible to like all children. However, if we will pause to consider why the unlovable child is the way he is—that people are not born that way but are the product of their constitution and their environment—we will find it much easier to work with the difficult unlovable child. One boy I recall rejected my every attempt to gain his cooperation and interest. It is perfectly human to react to rejection

with counterrejection. The only thing that kept me from doing so was my prior knowledge of his life history, how he had been shunted from relative to relative, none of whom wanted him. His parents bemoaned their inability to have him with them because the father's work involved constant traveling, but he was well aware that they also were glad to find an excuse to free themselves of the responsibility of a child. Thus some knowledge, or at least some awareness, that each child's behavior is his attempt to solve situations, to defend himself against dangerous feelings, is essential in working with children.

There are other techniques which may prove helpful. Recognize the child's feelings, in so far as you can. The child who comes to your office often does not know what to expect. He reacts to the unknown, and therefore the feared, in a defensive way. Maybe an example will clarify this: Sometimes a child will struggle against tears when in my office. A simple statement to the effect that many children feel afraid when they first come, and they do not know what is going to happen to them, that they are angry because they have been forced to come, often helps. I allow children to cry; they have the right to cry, to feel afraid. When they become aware of this attitude, they may burst into tears, but they also stop crying surprisingly fast, much faster than if I coax them not to cry. At times we are not sure how the child is feeling, but we can make some statement which gives the child the knowledge that we respect him as an individual who has a right to feel. Often this is enough to gain from the child some acceptance of you and of the office situation. Sometimes the child himself will then be able to put his fears, his anger, into words and this may help to lessen them.

As I mentioned, the child does not know what to expect. He may have been given a verbal explanation, but it is often dismaying to find out what the child has understood by it. The misinterpretation may be due to the parents' poor interpretation; at other times it is due to the child's own background of experience, which colors, what he hears. In addition, as already mentioned, parents transmit their own feelings to the child—their anxiety, bewilderment, or resentment. There is no hard and fast rule, but often a child becomes more quickly comfortable and cooperative if the preliminary interview is eliminated and actual testing is begun immediately. In other words, I rather quickly face the child with what he fears and therefore lessen the amount of anticipatory anxiety. Obviously this is not always wise. The results are not always reliable, but I use some task which I can repeat later when the child is more comfortable. Rather than increasing anxiety, this can have the effect of diminishing it.

In all cases, it helps youngsters to feel more secure if one structures the situation. By this I do not mean giving the child a long list of do's and don'ts; I do mean establishing at an early point that there are definite expectations and limits to the situation. Let me give an example. A definite time limit is stated at the beginning of the hour. For the frightened child this at least gives an "end in sight" to the terrifying situation. For children who basically enjoy the test materials but who also have a strong need to oppose any adult, this is a most helpful limit, both for the child and the adult. This kind of youngster, because he both wants and does not want to cooperate, is sometimes helped to do what he really wants to do by knowing his chance will be over in fifty minutes. It is

difficult not to get exasperated with this kind of child, who hurts himself and does not let us help him. What limits are necessary will depend upon your office situation. That there are definite expectations and limits within a situation increases the child's sense of security rather than lessening it. When the child senses that the adult dealing with him respects him, knows he has feelings too, but also has definite but reasonable expectations, that moment may be the turning point in gaining a youngster's cooperation.

In your work you need the child's active cooperation to reach an end goal which may be pretty vague to the child. One of the reasons children cooperate and are motivated to follow instructions is that they want to please adults. However, one of the strongest motives for all of us is that of self-interest, doing something for one's own benefit. If it is at all possible to help the child, particularly the older one, to see that his cooperation at the office and execution of home exercises are needed to help him rather than just to please his parents or you, then it is more likely that you will hold his interest. This would seem one of the most effective ways to motivate a youngster who is actively or passively resistant to authority.

Many children respond with more interest and are better motivated when they work in a group. The group situation, if the group is small, may be particularly good for a withdrawn child who is fearful of close contacts but who may through his silent observation of others more easily become involved in activity than when in close contact with a strange adult.

None of these suggestions will be effective with all children. Not only do you and I sometimes fail to get cooperation because we have not understood the child and have not realized his needs and fears, but we also experience failure when we attempt to help a child whose emotional problems are so great that no approach we can use will be effective. I cannot give you a neat list of the characteristics of those children who will not profit from your help, at least not until their emotional problems have been solved. With many children the best you can do is to try them; this takes time, which is often wasted time. You will have to observe the child to estimate the parents' role in the problem. You may request the parents to seek advice and help with the emotional problems before you come to any decision. It may be that after you have decided to work with a child, new problems arise. If the parent comes to you with the report that the child is suddenly showing behavior of a much younger child, you are necessarily troubled as to whether or not to urge parents to continue bringing the child. I would not immediately discontinue seeing the child, although regressive behavior is good cause for alarm. I would take time to speak to the parents, accepting with them the fact that the infantile behavior is very disturbing to them. They may be able to modify their demands upon the child, eliminate the nonessential demands, at least for the time being. If you reassure the parents that this regression does sometimes occur in response to treatment, they will find, from your acceptance, more tolerance for the deviation. If, after a few weeks, the child is still not able to give up the infantile behavior, you and his parents may come to the decision that the visual difficulty can-

not be corrected until some steps are taken to lessen the emotional conflict.

Certainly you have all come up against the youngster who is passively resistant, who holds on to his visual problem with a tenacity which is not lessened by your attempts to help him see what he can get out of it for himself, by any competitive goals within a group, not by any reward system. Some of these children cannot take any steps toward growth because nongrowth is so rewarding as a weapon against adults. Others cannot take any steps toward growth because improvement in vision (and thus, we hope, in reading) means loss rather than gain to the child. Perhaps his "problem" had become less a problem and more a means to get the attention he cannot otherwise get. Perhaps to him "growing up" means less love and more responsibility. Perhaps he is fearful of the implications of "growing up." Often the parents of these children do not want their children to grow up and become independent. Both parent and child in this situation present a very difficult problem. Prognosis is not good unless the parent, can be helped to allow the child to grow. When we find this situation operating, we search about to find something for the mother to substitute for her concentration of energies on the child. Children do not easily break away from this imprisoning relationship. The child is too dependent upon the parent to break away. By middle and late adolescence, when the child should be capable of standing on his own two feet, it is often too late. Too late, because he has grown into a weak, dependent, although hostile adolescent who does not have enough strength to break the bonds.

It is not enough to know what specific types of behavior mean; we also need to find ways to respond to it in order to lessen the child's anxiety, diminish his need to employ destructive defenses, and help him help himself to better vision and to a more comfortable, a more productive self.

TESTING THE PRESCHOOL CHILD

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BEFORE going into the field of orthoptics, I spent a number of years as a nursery school teacher, working with the preschool child. Although I will not go so far as to say that every orthoptic technician should have a similar background, greater emphasis should be placed on approved techniques and methods of working with children. It has frequently been apparent that we are working simultaneously on incompatible levels as we pursue our endeavors to help children attain better functional use of their eyes. We have techniques, instruments and instructions to work with, but these materials may be of no use if the child is indifferent, hostile or frightened. It goes without saying that the orthoptic technician must have the active interest and cooperation of the child.

The technician should be a good teacher with a confident and trained approach to children. She should possess a knowledge of their abilities and maturation at various age levels and exercise a sense of timing in introducing the ideas of new skills and habits when indicated. The child as an individual is her problem, and he comes to her with definite need for specific help. The methods used to carry out the training program, whether it is teaching a child to respond to a vision test, measuring a deviation on or off the amblyscope, or performing a series of orthoptic exercises, must be based on scientific criteria with an understanding of the educational and psychological findings of childhood behavior. The child will not give his best response unless ideas and suggestions are presented in such a way that he desires to put forth his best effort.

What I propose to do is to give some suggestions and possible solutions for the daily problems encountered when working with children, based on my own experience and found to be successful with children in school situations. I want you to consider this paper as mainly suggestive for further study.

Your first interview with the child is important. At this time he will sum up his impressions of you and form attitudes toward the things you require of him. The role orthoptists have in relation to their preschool patients is unique in that to most children under school age, adult authority has been experienced only in the home. The visit to an orthoptic office may be the first important step in preparation toward acceptance of other than parental authority. How you handle the first meeting may be a deciding factor in the success or failure of subsequent treatment. Although it is apparent that different methods work for different individuals, and each of us must work out his own techniques, I would like to relate my own routine for the first visit.

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The new patient and his parent enter your office. Greet them, of course, but avoid a greeting to which a response is expected from the child. An examination will start off on a slightly sour note if a child refuses to respond verbally to you. This is upsetting to you because your first reaction is that this child does not like you; it is upsetting to the mother, who feels that her child is being impolite; and it is upsetting to the child because he is being forced to make a response before he has decided what kind of a response it should be.

Consider yourself as a hostess, welcoming guests, wanting them to feel at ease as quickly as possible. Remember, the mother has little or no idea as to what may be expected of her or of her child, and she may be understandably uneasy, particularly if she feels her child may act in an unpredictable manner. If you are visibly relaxed, friendly and poised, you will find this attitude to be contagious.

Taking the history is next, and many technicians prefer to get this from the mother separately. I do not agree for several reasons. First, this history taking session gives the child a good chance to look you and the office over without being the direct center of attention. Second, children are frequently and unnecessarily apprehensive about their eyes, depending on the attitudes already established at home, attitudes you have no way of knowing. "Bad" eyes is a term frequently heard, as well as "weak" eyes, and of course, "cross-eyed." He is familiar with the terms *bad*, *weak* and *cross*, but usually knows them in their social context, and they all sound quite horrible. If you talk privately with the mother, the child may imagine all sorts of dreadful things are being said about him and about his eyes. The actual history, filled with fairly familiar words, can be deliberately phrased to be absolutely objective and factual. The child usually loses interest in what is being said as soon as he is reassured that it is commonplace. Frequently many clues as to the parent-child relationship can be picked up at this time. The technician establishes herself as a professional person during this interview, and conveys a great deal more than just what she actually says.

Up to this time your entire attention has been centered on the parent, with perhaps an occasional friendly smile for the child. Now the time for his part of the examination has come, and the shift of attention from the parent to the child should be marked. Some of us may feel that the parent's presence may be distracting to the child during the diagnostic examination. With children over four years old it can occasionally be taken for granted that the mother need not stay, but by no means make an issue of this point.

Before starting any test, take a quiet minute to look at the child with friendliness and warmth. At this point what you say may be less important than how you actually feel. I am curious and fascinated by the whole area of nonverbal communication with small children, but have been unable to find much on this subject in the literature. I am convinced that they can sense unspoken feelings in others. If we are unsure of ourselves, if we have any apprehensions, if we are inwardly in a turmoil or feel pressured by work, some of this reaches the child despite what we may say. These first moments of friendly regard and appreciation can give not only the child, but the technician, a sense of rapport

and empathy which can set the tone for the examination.

The following point would seem important. An orthoptic examination should not be considered a game. The referring doctor may have suggested that the reason for the orthoptic visit is to "play some games." This is not strictly true, certainly from a child's point of view. The word "game" means something quite different to him than sitting still and making required responses. There is no element of choice in what we have to offer him, there are no other children involved, nor can he stop when he wants. This examination, especially on the major amblyoscope, is like nothing he has ever done before, and likening it to television or movies, is quite farfetched to the child. I feel that misleading a child, even slightly, from the reality of a situation lowers you in his eyes. A normal, fairly well adjusted, secure child will rise to the challenge of something new and unfamiliar, especially if he can tell by your attitude that you will appreciate the effort he makes. Do not assume that he is going to try his hardest without encouragement from you.

Age characteristics are of value when used as a guide in thinking about children rather than as a rule or standard for judging an individual child. Let us consider what characteristics we can expect at preschool levels.

The two-year-old is noted for his brief attention span, rarely over six or seven minutes, and for his gross motor activity superseding finer mechanisms. He has little perception of and no interest in far-off objects; things close to him that he can touch and feel mean the most. If he must remain still for a time, he will accept the restriction more willingly if he has an interesting object in his hands to manipulate so that movement is still possible. The power to comprehend spoken language has begun by the time the child is two years old although ability to verbalize varies according to the child's individual development and intelligence. He will respond to a few simply expressed directions, but a short phrase, using the child's name, will prove most effective, especially if accompanied by gestures. He enjoys activity for its own sake and makes strong efforts to exert his independence.

By the age of three, there is greater self control on a motor basis, and he can be expected to sit still for longer periods of time if interested. He is able to listen well, and will respond to reasonable requests. In the Stanford Revision of the Binet Test, the three-year-old is expected to name correctly pictures of common objects: to obey simple commands; to talk about a picture shown to him; and to answer questions involving a simple cause-effect relationship. It is about this time that we can begin to look for and expect subjective responses which may help us determine how he is using his eyes. Mental growth between the ages of three and four is said to approximate that between six and eight, or nine and twelve. Gesell considers this age to be a period of calm between two storms of negativism and spurts of physiologic and mental growth.

The four-year-old has a strong motor drive with increased efficiency in his accomplishments. He combines talking with whatever he does, which in itself is an added skill. Although he enjoys bodily activity, he is able to sit for comparatively long periods of time if the occupation is interesting to him. Dealing with him will require a mixture of holding him in and

giving him freedom. Psychological tests expect more advanced indications of verbalization and interpretation than at three plus ability to count four objects and copy a cross.

The age of five is considered generally a well integrated period in the child's growth and development. He is better poised and more objective. In kindergarten, he is teachable, easily challenged and has improved emotional control. He can be helped to change undesirable habits and taught new substitutions through his reasoning and eagerness to imitate grownup behavior. Normal five-year-olds are expected in testing situations to name colors, not a test of color perception which is usually well developed by this time, but a test of verbalization of color perception. Ability to make simple associations between a sense impression and a name is present in normal children before the color associations are actually made. The five-year-old is a responsive orthoptic patient, especially if the attitude that he is expected to work is maintained. His imagination keeps training from becoming monotonous, and he enjoys moving within the securities of known and repeated routines.

There are some basic rules to be remembered in dealing with preschool children which I will reiterate here.

1. Success followed by praise is greater motivation than failure followed by reproof.
2. Language approval is superior to nonlanguage approval, and verbal handling in every case is preferable to physical handling.
3. Children like to take their time, especially in a new situation. Hurrying them along physically or verbally may result in negative reactions.
4. Positive, encouraging suggestions rather than commands are more effective. *Listen to yourself as you talk, making sure that what you say is simply expressed, unhurried and specific.* Keep your voice soft and low, but speak distinctly.
5. Playing with a child has unpredictable results and may backfire, for the child does not have the perception to realize when playtime has ceased and work begun. Do not try to be a child with children, they want you to be what you obviously are, an adult.
6. Tact is necessary to overcome timidity, and face-saving devices must be employed when the child feels that he is inadequate. This is important at all age levels, and particularly when testing vision of children in the six-to-seven year age range, because many of them are not sure enough of reading individual letters to be tested on the Snellen chart, yet they do not like to admit it.
7. Finally, enjoy what you are doing, and both you and your patient will have a better time.

Perhaps some of you have encountered the anxious child who is apt to say in a very worried tone, "Is that answer right?" It is particularly important to reassure him that straight reporting is what you require. Avoid terms with emotional content such as *good*, *bad*, or *wrong*. If you can establish what you expect of the child at first acquaintance, you will not be bothered or concerned at some later date by what you feel may be reporting distorted by a desire to please. If praise and encouragement are freely given the child feels he has nothing to gain by falsifying answers to gain your approval.

Guidance in learning consists of providing the kind of environment that will favor desirable modification in behavior, giving approval at indicated times. This is a basic rule for all orthoptic exercises, because many of them are based wholly on subjective responses. We want a child to make his maximum effort, yet we must give him credit for trying when the results fall short of what we desire for him.

If your first contact with the child has been a pleasant and successful one, he will leave your office feeling proud of himself, and may even spontaneously tell you or his mother that he has had a good time. I do not give suckers, gum, or even gold stars because it would seem that bribery or tangible reward changes the child's natural desire to please into one of material gain.

Though your first experience with the child has been successful, the following visits may not all be as rewarding, but the better you and the child know each other, the richer this relationship should become for both of you. When he is ready to start home exercises, you will, of course, spend plenty of time making sure that he understands them before even discussing them with his mother. The more direct responsibility that can be given the child in carrying out your directions, the more they are going to mean to him. Of this I am sure, a child is not afraid of something *you* may call work; it is only adults who have turned the word around to represent something to be avoided.

What we know in general of children's habits may be important to review at this point. A habit is made up of an original stimulus, and internal neural connection which has been learned, and an observed response. In trying to substitute a new reaction pattern, we must be sure that the substitute will bring more satisfaction than the one it replaces. This is why I put so much stress on the importance of praising the child at every step of the way. We have no way of knowing how much attention the child has been receiving because of his strabismus, but we can take for granted that it has been an attention-getting factor in his life. The child must be helped to understand that the change from crossed to straight eyes is desirable, and that he will not lack for attention if this change can be effected.

A few points of early childhood education have been cited which apply to orthoptic work, and now I would like to outline a few specific considerations:

1. Try objectively to evaluate your office attitude and present methods of working with children. You might try the experiment of selecting from your files a group of cases. Analyze them on the following points:

   a. How did you feel about this child? Did you like him or dislike him, or were you indifferent to him as a person?

   b. How do you think this child felt about you? Were his responses and progress motivated by his desire to please, by some understanding of his eye problem, or by fear?

   c. What factor do you believe contributed to the success or failure of any particular case? Are these factors based entirely upon the particular strabismus problem involved?

d. In the case of the failures, do you feel that a different approach to the child might have made a difference in the end results?

e. Do you feel that the successes were evidences of your individual ability, and the failures the fault of the child or his family?

2. Watch out for the hazards and temptations of a too efficient routine. Continually look beyond what tests you are doing to see the child's personality, his differences and abilities. A child can sense quickly your preoccupation with techniques and indifference to him, if such exists. Do not forget that this pair of eyes in which you are interested belong to a person; if you lose sight of this important fact, you may lose the cooperation which you need.

After you have faced your analysis of yourself, you may feel that you might benefit from further study of the field of child guidance and education. If so, turn to other specialized fields dealing with children, and do not hesitate to request advice and help. To be more specific:

1. Read current literature devoted to methods of working with children; there are many books and magazines which can offer good information from varied approaches.

2. Try to visit a nursery school or kindergarten as an observer. Find one recommended by your nearest university or teacher training center, and spend your time there in watching the teacher. There is no better way to learn such things as the compatability of kindness and firmness, positive direction, unemotional handling of childhood behavior. At the nursery school level, the relationship is simple and open, and because of its simplicity, is basic in any kind of a teaching situation.

3. Watch for the newspaper notices of lectures, usually sponsored by PTA groups and open to the public, where trained educators and psychologists discuss problems of children.

4. Adult education programs in many of the larger cities offer a variety of courses on various aspects of child study. Here you will have the opportunity to learn the current thinking in the field and by applying what you learn, make your own profession more rewarding.

Our individual responsibility is to help raise the standard of the orthoptic technician's professional status and implies a dedication to pursuit of the knowledge necessary to bring about high level performance in all respects.

THE ROLE OF SEMANTICS IN ORTHOPTICS

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IN any situation that requires a subjective response, words are basic tools in communication. In orthoptics, communication can be achieved either on a verbal or on a nonverbal level. Semantics is primarily concerned with the clarification of communication between people and the clarification of one's own thoughts and responses.

The definitions of semantics are as follows:

1. The scientific study of the meanings and the development of the meanings of words; semasiology. 2. The scientific study of the relations between symbols or signs and what they denote, including the emotional and unconscious reactions of individuals to particular symbols.

In our work as orthoptic technicians, it is with this second definition that we are primarily concerned. To make it clear we must realize that words are actually symbols.

In our daily work as orthoptists we must communicate with patients, parents, doctors and other technicians. To convey our ideas we must be able to explain, teach, and speak on their levels of understanding. Very few of us would tell a mother that her child had a concomitant esotropia with an *amblyopia ex anopsia.* Yet some of us, when using the more sophisticated amblyoscope targets, may unthinkingly ask a small child to identify an object for which he has no word. He must be taught that this is a picture of a lion, or a picture of a soldier in a sentry box.

You will notice that I included doctors and technicians in my list. It is surprising to find out that you are not communicating effectively with another person of similar background and training. Presumably you have both acquired the same vocabulary, but on closer examination, perhaps this is not true.

Two phrases can serve to illustrate this fact: *intermittent exotropia* and *fixation disparity*. From any group of specialists various definitions would be forthcoming if one asked each person to define each of these entities. It is obvious that a letter of referral using one of these phrases without specific definition, may mean something entirely different to the writer and to the recipient.

One of the first occasions in my orthoptic training in which there was a definite practical use of semantics, was a demonstration of Miss Julia Lancaster's method of teaching a child diplopia and fusion with a red filter: First, a demonstration of the red color, then the white color, then asking if there are two. Take the two objects closer together, asking when they fuse, if the object is red, white, or different. The key word here is *different*. All of you know that the fused image is not pink, as a carnation is

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pink, and the use of the word *pink* will often confuse a child. In a personal letter Miss Lancaster says that after the child has learned the fused color as *different*, she conditions him to use the shorter word *pink;* but only after teaching him that this is not the pink that he has formerly known. She has given other examples of semantic difficulties she has encountered:

> . . . Another good example is "in and out" (lion in the cage). The confusion being "out of the *cage*" and "out of sight." This has led to tremendous errors in diagnosing anomalous correspondence. For "out of the cage," I like "crooked" and save "out" for "out of sight" . . . . "The lion is *bigger*" is often used by children to mean he is too high to fit, not anisekonia . . . .

The list could go on indefinitely with each of us adding our own examples. My own favorite example is one which I am sure will never happen again. It involves the word two in the sense of duplication of an object. In doing vergences on an adult patient I was accustomed to say, "Look at the light at the end of the room and tell me when you see two." One of the patients did not respond even though he was obviously alternating after reaching his maximum divergence. This particular patient was a mathematician, and *two* meant the Arabic numeral to him. He was patiently awaiting the appearance of a number on the light! Needless to say, my introductory statement to the patient has now been revised.

Farfetched? Yes, but a good example of what easily might go through any patient's mind when confronted with a new usage of an old, familiar word, or a word which has a particular subjective meaning. I am not suggesting that we invent or use entirely new words in our work. This would not be feasible, I merely mean that in using familiar words, we must be very cautious to use them in such a way as to make them clearly understood *in the particular situation.* Most of us are very much aware of this problem in dealing with children. Sometimes we overdo the "reaching down to his level" and receive only scorn from a child with an advanced vocabulary. This is usually called "talking down to him."

This may lead to a great deal of confusion and we may be inclined to say, "So what if I do use words wrong occasionally, what can I do about it?" Or even, "Why bother?"

What we can do about semantic blocks and misunderstanding is primarily on two levels: help on patient approach and improvement in professional inter-relationships. First of all, a patient must be given a vocabulary sufficient to express what he feels, sees and means. For children, simple words are best, presuming you have taught the child their meaning for the particular situation. Hand signals may be more effective than speech, if a chin rest interferes with speaking. The semantic problems of an adult are usually of a different nature, but they stem from the same basic source. He can express himself, but oftentimes not clearly or accurately. He also, must be taught an effective vocabulary. An intelligent, cooperative patient appreciates a concise explanation of his difficulty. Often he wants to know the exact terms used to describe his trouble and your exercises. In general he is anxious to communicate with you on your level. Other patients prefer a somewhat less complicated approach.

Professionally we should clarify our own terminology so that we can more effectively speak and write about our patients and our work without having to define our words so extensively. Clarification of thought naturally goes along with the clarification of terminology. When we are able to express ourselves adequately, we are far more likely to be able to help other people express themselves. Often reading one of the more basic books in semantics can help immeasurably.

To get back to "why bother?" I think that the effort made to give direction explicitly and to choose our words with accuracy and precision is important because we may often find our inability to establish a working relationship with a patient is due to misunderstanding of directions. You have all had patients who were able to state their symptoms clearly, cooperate in therapy, and express the measure of their relief at the end of the treatment period. Because they had a clear understanding of their malfunction, it was easy to help them, for they were therefore capable of evaluating any improvement.

On the other hand, you have probably also had patients who were unable to state their symptoms clearly: Such a patient has not learned to analyze his visual experiences. His recital of symptoms, however severe, is vague, often ending with a shrug and "You know what I mean." You *may* achieve good objective results in treating this patient, but you never know how much you may have helped him. The same inability which prevented him from explaining his initial difficulty is very likely to prevent him from telling you of his complete relief. But if you have carefully formulated your own concept of this malfunction, you may help him to an appreciation of his symptoms and, hence, a clearer verbalization of them. The time will be well spent, for with his new understanding of the problem, you will be much better able to treat him effectively.

CONCLUSION

The importance of semantics in orthoptics is twofold: in our relationships with patients, and at the interprofessional level. When we are unable to "get through" to a patient, to a parent, or to another technician, it is wise to investigate and evaluate the words we have used. We might be speaking on one level of understanding, and our listener might be hearing on another.

SELECTION OF ADULT CASES FOR ORTHOPTIC TRAINING AND OUTLINE OF TREATMENT

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IN the selection of adult cases for orthoptic training, I have classed as adults those patients over fourteen years of age. This paper is intended as a review and as an outline of treatment.

When treating adults, age and general physical condition must be considered. Patients who are generally in poor health usually do not respond favorably to orthoptic training and are often unable to come for exercises regularly. However, if the disability is due to eye strain, such as headache or asthenopia due to defective muscle balance, it may be worth while to undertake treatment, providing the patient is cooperative, willing to attend training periods regularly and conscientious in following instructions for home training.

The only patients who should be treated are those with fairly strong binocular vision and partial stereopsis. If the case is not suitable for treatment but the patient has diplopia, the orthoptic technician may encourage him to ignore or suppress the second image, if fusion is not possible.

When treating adult patients, the orthoptic technician must be ever mindful of the danger of producing diplopia in a patient with fusion insufficient to overcome such diplopia, or with incomitant strabismus, or with a small residual angle of convergence postoperatively upon which the ophthalmologist does not think it advisable to operate. If a teen-age patient has no binocular vision and if careful examination indicates that binocular vision will probably not be possible, then surgical correction should be first considered, whether diplopia does or does not exist. Most of these patients will have relief from the diplopia within a week or two after surgical intervention. The cosmetic result is of major importance to these patients but a postoperative orthoptic survey should be done and treatment given if there is any hope of a functional result. It is often surprising that young adults on whom no fusion is elicited preoperatively, may have some binocular function after surgical correction. Although orthoptic training may not develop the fusion amplitudes which we consider normal, still they are often sufficiently strong to hold the eyes in good binocular alignment. In my experience, these patients, with two exceptions, had undergone surgical correction for exotropia.

If, on the initial examination, the patient appears to have some binocular vision, if the visual acuity is good, if the history is favorable, and if the movement of the eyes is concomitant, then a trial course of treatment is indicated.

In considering the possibility of postoperative diplopia, it must be re-

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membered that adults with an amblyopic eye, even those with less than 20/200 vision, often experience a postoperative diplopia. The orthoptic technician should place prisms of a strength equal to the angle of squint before the eyes and ask the patient to fixate objects from infinity to near and note whether or not diplopia occurs. If the case is one of monocular strabismus, the image seen with the normally deviating eye will usually be less clear than that seen with the normally fixating eye, and the patient can be instructed to fixate the clear image should he experience diplopia after surgical correction. Most surgeons emphasize the risk of diplopia to the preoperative patient and give him some instruction as to how best to overcome or deal with it should it occur during the week or ten days which might elapse before his first postoperative visit to the orthoptic clinic.

Adult cases of esotropia are measured before surgical correction is done and are treated postoperatively only if they exhibit a phoria or an intermittent tropia. These will be discussed under the classification of heterophoria. Muscle imbalances of the following types will be discussed in regard to their diagnosis and treatment:

I. Intermittent divergent strabismus

II. Divergence excess

III. Heterophoria
   A. Convergence deficiency
   B. Exophoria
   C. Esophoria
   D. Hyperphoria

INTERMITTENT DIVERGENT STRABISMUS

There are two types of intermittent divergent strabismus:

(A) The patient has binocular vision and some stereopsis. In these cases if the angle is large, surgical intervention is necessary before treatment. (B) The patient has no binocular vision. There are two classifications for patients in this category: (1) those up to about thirty years of age who have no binocular vision and in whom one can expect only a cosmetic result; and (2) those with intermittent divergent strabismus with no simultaneous macular perception because of a large and dense area of suppression. If tested with a −3.50 diopter sphere in either eye and a peripheral fusion slide, these patients may be found to have fusion and some stereoscopic vision and they can be treated. If the deviation is small and fusion convergence poor, they usually do well and the angle of deviation will often decrease to zero, although it may remain stationary. If the deviation is rather large, the patient will often be able to fuse at zero by exerting some accommodation, but will not be comfortable. When the technician has decided that treatment alone will not correct the deviation, she should attempt to eliminate the area of suppression and encourage the patient to relax to his most divergent angle on simultaneous macular perception targets. After surgical correction, postoperative convergence training is carried out. The patients with intermittent divergence who have binocular vision at a very divergent angle fall into this category.

The orthoptic prognosis is poor in any case of divergent strabismus in which there is good adduction and good fusion convergence. The less adduction and fusion convergence there is present at the onset of treatment, the better the chance for successful treatment. If the patient does not demonstrate any binocular function

on the major amblyoscope, concave lenses of -3.00 or -3.50 diopters sphere should be inserted in the lens carrier for either eye. Binocular vision that could not be elicited without the concave lenses is often found to be present. In both testing and primary treatment, if hyperphoria is present, the fixation object should be placed before the eye with the primary deviation. It is quite permissible to start treatment with either second or third grade targets and then return to the first grade simultaneous perception targets.

DIVERGENCE EXCESS

This condition may be difficult to cure even with surgical intervention. It must be remembered that bright lights, excessive fatigue, emotional upsets or severe illness may cause a divergence excess to break down into a manifest divergent strabismus. Control of the eyes can usually be taught in these cases. The patient's vision will return to normal when the environment again becomes favorable.

Treatment

Treatment for divergence excess can be carried out in the following manner:

1. If possible when the eye diverges, establish conscious diplopia with the red and green glasses and light.

2. If the angle is very wide—twenty to thirty degrees, surgical correction will be necessary and should be followed by convergence training.

3. If binocular vision is not present and the patient has incomitant strabismus, surgical intervention is necessary unless a convergent angle can be obtained with concave lenses. Orthoptic treatment is given postoperatively if indicated.

4. If the patient with divergence excess has good fusional convergence, the prognosis is poor because nothing can be done to strengthen binocular vision in this instance.

5. Dark glasses should be worn, especially in tropical climates, to protect the patient from bright sunlight, which favors the deviation becoming manifest.

6. For a good result, a great many home exercises should be given.

7. The exercises must at first be simple, working up to jump convergence and finally to voluntary convergence both on and off the major amblyoscope. The patient must have a good fusion reserve.

8. During treatment it is important to encourage the divergent patient to see the pictures clearly, since this will stimulate accommodation and will, therefore, stimulate convergence.

HETEROPHORIA

Convergence Deficiency

In heterophoria the convergence deficiency may be demonstrated by the absence of the power of convergence or by a poorly sustained power of convergence.

In diagnosing a convergence deficiency with heterophoria, the *Maddox rod or prism cover test* will usually show no appreciable deviation. If there is an exophoria, it will usually be less at distance than at near. The *Maddox wing test* may show any reading from orthophoria to thirty diopters of exophoria.

A very bad convergence deficiency may not be binocular at near. I like to use the A card on the Walraven bar separator, asking the patient to point to the *A's* and count them. If the patient alternates at near, it is readily detected with this test. A small line or pen point is best for checking the near point of convergence. There may be no recognition of diplopia because of central suppression. This test must be done more than once, and one should ask the patient if he is aware of diplopia when the eye deviates. Our doctors like to have us chart which eye deviates most frequently. There will be poor fusion convergence on the major amblyoscope, and this test should be repeated more than once; it may be adequate on the first try but decrease on subsequent attempts.

Subjective Symptoms

The patient may complain of headaches, blurring of print for reading, or dancing of print. Occasionally there may be nausea and even vomiting. Sometimes the patient will relate that he feels as though only one eye were moving when he is reading. Diplopia while doing prolonged close work is a frequent symptom. Ocular fatigue and drowsiness are common. Some patients complain of headaches in the morning following prolonged close work the night before, and some state that they must move away from people to whom they are talking.

Management

Measure the angle of deviation on the major amblyoscope with simultaneous foveal perception targets and evaluate version movements, which should be comitant. Test the amplitudes of divergence, convergence and stereopsis. If fusional convergence is poor, insert concave lenses up to three or four diopters in the lens carriers of the major amblyoscope. These may be used until the patient can converge to forty-five diopters and with them can fuse at twenty diopters base out. Then remove the lenses while he maintains fusion and increase convergence again. When he can converge to sixty diopters without lenses, jump convergence and voluntary convergence should be practiced. He must be made to hold the pictures clear while converging thirty or forty diopters if possible. The patient should have good voluntary convergence off the instrument as well as on it. In the average case, with good cooperation from the patient it is possible to achieve the desired result and have him ready for discharge after six clinical treatments. He should be instructed to continue some home training in order to maintain the control and good muscle tone which have been achieved and so prevent a return of symptoms. This is especially necessary for adults past the age of 40. The diploscope is valuable in these cases and should not be overlooked. Some patients need spend only five or ten minutes a week, while others must do the home exercises at more frequent intervals and for a longer period at each session.

With a few degrees of esophoria as measured by the Maddox rod test, there may still be a convergence deficiency present. It will be diagnosed by inability of the patient to converge normally. Convergence exercises followed by divergence exercises must be given both in the clinic and at home. The simultaneous perception angle must be checked and care taken that a convergence spasm does not develop. It is not unusual to find a

convergence spasm in which the patient will suddenly fuse not at orthophoria, but at convergent angle of ten to twenty degrees. Such a patient complains of blurred vision and it is important to help him to relax this spasm.

Accommodational fatigue may occur in cases with practically no convergence amplitude. It can be an early symptom of multiple sclerosis, and such diagnosis should be ruled out by the ophthalmologist before treatment is instituted.

Exophoria

With an exophoria for distance and near, if the patient can converge and the deviation is less than twenty diopters, treatment may help. When there are more than fifteen diopters of divergence, surgical correction may eventually be necessary. If a patient has no convergence, even while accommodating, the essential treatment is surgical.

Cases with exophoria for distance and orthophoria for near are of the divergence excess type, and when the exophoria for distance is comparatively small, they are usually quite responsive to treatment.

Orthophoria for distance and significant exophoria for near constitute a group of patients with convergence deficiencies which respond readily to convergence exercises.

Exophoria with hyperphoria becomes occasionally a manifest divergence for distance. It is this type of exophoria which often breaks down into manifest divergent strabismus. Orthoptic treatment may help if good convergence and fusional reserve can be obtained. This type of exophoria is often found in middle-aged people.

The small exophorias and convergence deficiencies produce more symptoms than any other type of heterophoria.

Esophoria

Esophoria at both distance and near is the type of esophoria most likely to break down under strain and become a manifest convergent strabismus. If the deviation is less than ten diopters, orthoptic training may help, but if the angle is greater, surgical correction may be necessary.

In cases of esophoria at distance and orthophoria at near, the prognosis is even less satisfactory. The patient has binocular vision and is comfortable at near, but has a divergence insufficiency manifest on distant fixation. If the measurement at distance is in excess of fifteen or twenty diopters, surgical correction is usually required.

Where there is slight esophoria at distance and more esophoria at near, the esophoria is often due to an upset in the balance between accommodation and convergence. Orthoptic therapy may help the patients in this group.

Slight esophoria at distance with orthophoria, small esophoria, or small exophoria at near are symptoms which really mask a convergence deficiency. Here the convergence must be dealt with before treating the esophoria. Often the symptoms are relieved by the time the convergence has been trained, but each lesson in the clinic and at home should end with some relaxation exercise.

Only those esophoric patients with symptoms are treated with orthoptics. With careful selection of cases the results are good, although esophorias are slower and more difficult to treat than any other type of heterophoria. The aim of treatment is to render the patient symptom free. In some cases the esophoria is reduced or brought to normal, but there are other patients who show no improvement in the actual measurements, although they may have relief from symptoms. They have acquired a fusion reserve sufficient to compensate, and if this is maintained, they may have no further trouble.

Hyperphoria

In pure hyperphoria, manifested by deficiency or overaction of a vertically acting muscle, orthoptic treatment is not of great value. If the hyperphoria is small, a vertical prism will help; if large, surgical correction may be necessary. When there is no apparent reason for one eye being high and the hyperphoria is comitant, a vertical prism is often most helpful.

Hyperphoria associated with esophoria or exophoria occurs occasionally. Cases of hyperphoria are associated with exophoria more frequently than with esophoria in my experience. As the exophoria is reduced, the vertical deviation may decrease; if it does not, a small vertical prism may be given. If the hyperphoria is associated with esophoria, it appears to decrease less frequently than a hyperphoria associated with exophoria.

Hyperphoria and Hypertropia

In an adult, hyperphoria is usually of the traumatic type. These patients should be treated in the early stages, and as soon as the occluder can be left off, it should be discarded. If the vertical separation is wide, prisms may be used either constantly or for a time each day. Prisms may be gradually reduced when fusion is possible without them.

Some adult hyperphorias which suddenly produce symptoms seem to be helped by toning up the convergence and increasing the range of fusional divergence. If this is not sufficient, vertical prisms incorporated in the glasses are frequently necessary in comitant hyperphorias. Surgical treatment may be required in paretic hyperphoria or hypertropia of significant degree.

Adult patients, with a ciliary spasm as evidenced by blurred vision, pain in the eyes, frontal headaches, or nausea must be taught to relax. The ophthalmologist may use atropine to relieve this spasm. Office treatments are supplemented with home exercise if necessary. The patient must be given a good range of fusion amplitude.

In conclusion, the problems involved in the orthoptic management of adults are quite different from those encountered in children. Only those patients with symptoms should be treated. Proper evaluation of the adult patient with a muscle anomaly can be most rewarding.

SPASTIC AND CEREBRAL PALSY SQUINT PROBLEMS

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THE spastic and cerebral palsy patients encountered by the ophthalmologist in his practice comprise one of the most pitiful and one of the most interesting groups of cases. At the same time they are one of the most difficult to treat and to evaluate.

Before discussing the problems of strabismus in the cerebral palsy patient it is necessary to define and limit the term. Here we immediately run into difficulty because the term *cerebral palsy* does not designate a disease in the usual medical sense. It covers individuals who are handicapped by motor disorders and a paralytic state resulting from cerebral damage of any nature. The brain damage most frequently occurs early in life so that abnormalities of prenatal development, birth injuries, and the consequences of infection or injury in infancy and early childhood are included. The diagnosis *cerebral palsy* also means that the brain lesion is nonprogressive and that no active disease exists. Even the classification of various types of cerebral palsy is not generally agreed upon. There are three principal groups of cases: (1) spastic, (2) extrapyramidal and (3) mixed types.

The spastic cases include most of the paralytic types and are associated with lesions involving the pyramidal tract.

The extrapyramidal cases include incoordination and various disorders of movement, and the involvement of supranuclear connections of the lower cranial nerves. Athetosis, or slow writhing movements, and chorea, which is a jerky, irregular series of movements, are examples of the incoordinate movement. Facial grimacing, drooling, and speech difficulties are examples of the disorders of muscles innervated by the lower cranial nerves. Overlapping mixed types occur.

Furthermore, the motor and coordination problems are not the only difficulties which the cerebral palsied child must bear. Frequently these are of less importance than the mental retardation, ocular and hearing defects, and other sensory deficiencies which may accompany the original brain damage.

The incidence of cerebral palsy is another consideration in this discussion. Perhaps these figures will be of interest: in every 100,000 population there are born seven infants destined to have cerebral palsy. Of these, one dies, two will have such serious impairment of intellectual faculties that any program of effective training is impossible, one will be so crippled that rehabilitation for self locomotion is futile, two are moderately handicapped physically and can be rehabili-

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tated, and one has only mild involvement, little difficulty and makes a very easy rehabilitation and adjustment.

In routine ocular examination of cerebral palsied children, strabismus is encountered in a high percentage of cases. Guibor, in his series, found motor defects in 75 per cent, of which 51 per cent had esotropia. Breaky noted an incidence of esotropia in 40 per cent of a series of one hundred cases. In my own series of three hundred and fifty cases, strabismus was encountered in 15 per cent. Twenty-nine per cent of these were esotropic. There is a great difference between the incidence of strabismus in my series and in the other two mentioned. One explanation may lie in the types of cases of cerebral palsy found in the series. Strabismus is found in a majority of the spastics, (60 per cent or more) but it is not seen so commonly in the extrapyramidal cases—the athetoids and choreas.

Ocular defects other than strabismus are found in the cerebral palsy group. Subnormal vision is encountered in 10 to 25 per cent of the cases, depending on the series. High refractive errors are quite common, and optic atrophy is seen in 2 to 3 per cent of cases. Visual field defects are also found, although it is difficult to test for these.

In the routine ocular examination of cerebral palsied children with squint, the ophthalmologist encounters a multitude of obstacles which render adequate examination, evaluation and proper treatment most difficult. Many of these patients are seen at an extremely early age, and the ocular examination of any child aged 1 to 3 years puts most of the emphasis on the objective examination and relies on the observational powers of the doctor. Naturally, some of these patients are older than 3 years, in fact a good many are. A great number of them are mentally retarded. We must realize then that in over 50 per cent of cases there is an intelligence quotient (IQ) of less than 70. In about 50 per cent of cerebral palsy patients, there is an associated speech defect which further hampers successful examination. Also, spasticity, rigidity, choreiform and athetoid incoordinated writhing movements, poor posture and inability to hold the head up, all contribute to an examination which is far from standard and must be filled with inaccuracies. Most of these children, cannot communicate with you or you with them. Mental sluggishness hinders their comprehension of what is desired of them; poor posture and motor difficulties prevent their adequate cooperation. Visual acuity is testable by some means in about 32 per cent of the cases. Most of the examination depends on the experience of the ophthalmologist in handling these cases. A glimmer or sudden lighting of the eye indicates recognition of a letter or a figure during vision testing. A grunt or muffled incomprehensible sound means the child knows he must look at the muscle light and will cooperate.

In most of the cases we cannot obtain a good determination of visual acuity. We must decide from observation whether the child is able to fix with either eye, and whether he has reasonably equal vision. Ocular rotations and versions are studied and convergence is tested. By arousing enough interest in the child, a reasonably accurate prism cover test is possible in most, if not all, cases. A refraction is done under cycloplegia. The retinoscopy must be performed with maximum care and accuracy be-

cause in the majority of cerebral palsy patients the lens prescription depends exclusively on the finding. Of course, the older children and those with less severe brain involvement are better able to cooperate to a variable degree in the examination but this group of children represents a small percentage of those seen by the ophthalmologist.

Although high refractive errors, including high astigmatic errors, are found in a relatively large number of cerebral palsy children, a favorable response of a squint to correction of the refractive error is not usual. The percentage of accommodative squints is relatively low.

A fair number of these children have a monocular amblyopia, although I cannot at this time give statistics. This finding may be present in patients with strabismus, and I have discovered it in nonstrabismic patients also. The treatment of this amblyopia is difficult because these children have so many disorders that occlusion is an added burden in most cases. I have found the response to occlusion discouraging in most cerebral palsy cases. In most cases of strabismus in cerebral palsied children, an attempt is made first to give them the best possible visual acuity by prescribing a suitable lens correction when indicated. If feasible, I try to improve the visual status of an amblyopic eye by carefully observed occlusion. Muscle studies are carried out to give a good idea of the average measurement of the deviation present. If the mental level and status of the child warrants it, surgical measures are employed to improve the ocular alignment and position. The mental level of the child is considered because of the economic factor involved. These children are often a financial burden to their parents and often require aid from the community and the state. In many cases state aid funds must be required for surgical care and hospitalization. In a few instances private insurance funds cover the case. In many cases further treatment by orthopedic surgery is required to rehabilitate the child for self-locomotion, so that he may have some measure of self-reliance. Surgical correction of ocular malfunction is warranted when there is a chance that some improved ocular coordination will result, and when the child is of a sufficiently high mental level so that he will be able to take advantage of the improved ocular position and is not likely to be institutionalized for his mental and physical handicaps.

In surgical intervention for strabismus in cerebral palsy cases, judgment and restraint must be exercised. The response of these children to surgical procedures on the ocular muscles is not nearly as predictable as is that of a normal child with strabismus. In general, a little surgery done on a few ocular muscles at a time brings successful results in a cerebral palsy case, and bold attack on several muscles leads to overcorrection. This applied much more to esotropias than to exotropias. An esotropia of 45 to 50 diopters which in a normal child, may require a bilateral recession of the internal recti of 4 to 5 mm., may result in a exotropia of 30 to 50 diopters if treated in the same way in a victim of cerebral palsy.

Now, where does the orthoptist fit into this picture? Frankly, in most cases orthoptic therapy is not required. Training these children to coordinate their limbs in even a basic, grossly functional manner is a task for the physiotherapist and occupational therapist, and in the majority of cases developing fine ocular coordi-

nation and fusion would be impossible. There is usually too much physical and mental deficiency to be overcome for there to be any satisfactory orthoptic ocular rehabilitation.

In those children with minimal cerebral palsy involvement in whom a squint develops, orthoptic therapy is prescribed when indicated, just as it is in any other suitable squint case, and the results are comparable. There are other borderline cases; we have seen some strabismic children with more than minimal cerebral palsy involvement who have responded to treatment with orthoptics, but on the whole these are isolated cases.

The cerebral palsied group is fortunately a small one. It is discouraging to see these children so greatly afflicted and for whom we can do so little in so many cases. The orthoptist sees only a few such cases because the general mental and physical limitations of most patients with strabismus in this group make them unsuitable candidates for orthoptic therapy. The ophthalmologist is one of the team of specialists involved in the general survey and rehabilitation of the cerebral palsied child. We too must be satisfied in most cases with a limited degree of visual and ocular motor improvement, achieved only after much persistence and effort. These children have so little to look forward to that it is a personal pleasure to contribute even a little to improve their ocular function and comfort.

NEW PROCEDURE FOR COLLECTING RECORD DATA

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IN January 1960, plans were established for a clinical research project in ocular motility at Walter Reed Army Medical Center. Comprehensive statistics of the many variables involved in the etiology and treatment of strabismus have never before been recorded or analyzed by computers, although many ophthalmologists agree that it is only by a study of thousands of strabismus cases that the value of the various types of treatment will eventually be learned.

Limited studies conducted by individual ophthalmologists have been published, but usually the analysis has been confined to one variable, the number of cases recorded has been small, and computers have not been utilized. A group study which was initiated by the Committee on Evaluation of the Nonsurgical Treatment of Strabismus of the American Academy of Ophthalmology and Otolaryngology was not pursued because uniformity in procedure could not be adequately maintained.

It is evident from recent symposiums and publications that much disparity and variation exist in the consideration of proper treatment. The idea of beginning therapy early in life has been well accepted, but the common question as to just what the proper treatment is in any given case still remains. Because of the over 200 variables and the marked differences of opinion, there is much confusion as regards treatment. At Walter Reed Army Medical Center the situation has been of concern to the physicians who enter the field of ocular motility. Spurred on by their interest in seeking suitable treatment for each individual and encouraged by the opportunity presented in the large number of strabismus patients who come to the eye clinic, the ophthalmologists established the Muscle Clinic in the Department of Ophthalmology as a research project.

Walter Reed Army Medical Center has been considered a suitable place for this study because (1) the hospital has a large eye clinic, with a high percentage of cases receiving surgical correction; (2) most of the patients to be included in the study were military dependents, making close contact and check-ups not too difficult; (3) the resident staff expressed an interest and a desire to participate in this study; (4) Walter Reed Army Medical Center already has adequate facility for the study plus the cooperation of the International Business Machine staff in doing the coding. For future purposes this study could be considered as an evaluation of the use of automation in the field of clinical medicine. The entire program will be under the supervision of one ophthalmologist, ensuring adequate control of the treatment program.

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V ORTHOPTIC REPORT

Name		Age	Date
V. A. Far sc OD	cc OD	Near sc OD	cc OD
OS	OS	OS	OS
OU	OU	OU	OU

	sc	cc		sc	cc
C.T. Far			C.U.T. Far		
Near			Near		

NPC	Bar reading		sc	cc
sc red glass	( ) good	Red glass		
	( ) poor		Far	
cc red glass	( ) none		Near	

N.P.A. sc OD	cc OD	Worth 4 dot	sc	cc
OS	OS	Far		
		Near		

Dom. Eye	Far	Near	Handedness	Head Tilt	Face Tilt	Chin Tilt

Afterimage	Stereopsis (Type of test)	Visuscope (Type of fixation)

Amblyoscope: sc cc	Amblyoscope: sc cc
Far - Obj angle	Near - Obj angle
Subj angle	Subj angle
Superimposition	Superimposition
Retinal Correspondence	Retinal Correspondence
Suppression	Suppression
1st gr. targets	1st gr. targets
2nd gr. targets	2nd gr. targets
Fusion	Fusion
D - R - C - R -	D - R - C - R -
Blur Point Clear Point	Blur Point Clear Point

Remarks

It was agreed that a complete program would include the services of an orthoptist. With a full-time orthoptist on the staff, this aspect of the therapy could be completed. The orthoptist makes an orthoptic analysis on each patient during the initial visit and prior to surgery, evaluating the amount of eye coordination and binocular single vision and skill. A similar analysis will be made six weeks after surgery and again two years later. The orthoptist also directs the orthoptic treatments, pre and postoperatively.

ORTHOPTIC FOLLOWUPS

Name
Date

	Far		Near	
Date				
	Obj angle	D	Obj angle	D
	Subj angle	R	Subj angle	R
	Superimp.	C	Superimp.	C
	Ret. Corresp.	R	Ret. Corresp.	R
	Suppression		Suppression	
	Fusion		Fusion	
	Other Rx		Other Rx	
Date				
	Obj angle	D	Obj angle	D
	Subj angle	R	Subj angle	R
	Superimp.	C	Superimp.	C
	Ret. Corresp.	R	Ret. Corresp.	R
	Suppression		Suppression	
	Fusion		Fusion	
	Other Rx		Other Rx	
Date				
	Obj angle	D	Obj angle	D
	Subj angle	R	Subj angle	R
	Superimp.	C	Superimp.	C
	Ret. Corresp.	R	Ret. Corresp.	R
	Suppression		Suppression	
	Fusion		Fusion	
	Other Rx		Other Rx	

It is the intent of this paper to present the forms on which the data will be recorded for coding and statistical evaluation.

In the first study only surgical cases will be under consideration. A thorough evaluation of each case will be computed prior to the surgical procedure, six weeks postoperatively, and again two years postoperatively. Over two hundred variables will be included in the analysis, and results will be coded onto International Business Machines (IBM) cards. After several hundred cases have been coded, a statistical analysis will be prepared which will serve as a registry for strabismus. The study will continue over a period of years.

Each strabismus case enlists the use of fourteen cards with 80 columns each for coding. Cards 1 to 10 include history, previous treatment, first examination at Walter Reed Army Medical Center, followed by subsequent treatment and check-ups by the ophthalmologist. Cards 11 to 14 include the orthoptic evaluation and treatment.

For the benefit of orthoptists interested in establishing a similar coding system, card 11 records the initial

orthoptic analysis and therapy; card 12 records the immediate preoperative examination and immediate postoperative therapy; card 13 records the six-week postoperative examination and therapy, and card 14 records the two-year postoperative analysis and treatment. The same outline is used on all four cards.

Treatments are recorded under specific headings according to the objectives desired. The activities suitable to each heading are arranged in groups according to their similarity and, in some instances, according to the need for increased skill in performance.

Attached is an outline of the Muscle Research Project, the codes, and the IBM coding sheets. By the use of this method of recording and evaluation, it is hoped that a more comprehensive statistical evaluation may be possible.

REFERENCES

1. Wheeler, Maynard C.: Punch cards for motility records, AMA Arch Ophthal, 59:603-606 (April) 1958.

ORTHOPTIC EVALUATION CODE

Register Number 1-7
Card Number 8-9

11—Initial examination and therapy

12—Immediate preoperative examination and immediate postoperative therapy

13—Six-week postoperative examination and subsequent therapy

14—Two-year postoperative examination and subsequent therapy

A. First Visit 10

Correction
(1) With
(2) Without

1. *Red Glass*
   a. *Near* 11
      (1) Fuse
      (2) Diplopia
      (3) Suppression OD
      (4) Suppression OS
      (5) Suppression Alternating
   b. *Far* 12
      (1) Fuse
      (2) Diplopia
      (3) Suppression OD
      (4) Suppression OS
      (5) Suppression Alternating

2. Worth 4-dot
   a. *Near*
      Foveal 13
      (1) Fuse
      (2) Diplopia
      (3) Suppression OD
      (4) Suppression OS
      (5) Suppression Alternating
      Parafoveal 14
      (1) Fuse
      (2) Diplopia
      (3) Suppression OD
      (4) Suppression OS
      (5) Suppression Alternating
   b. *Far*
      Foveal 15
      (1) Fuse
      (2) Diplopia
      (3) Suppression OD
      (4) Suppression OS
      (5) Suppression Alternating
      Parafoveal 16
      (1) Fuse
      (2) Diplopia
      (3) Suppression OD
      (4) Suppression OS
      (5) Suppression Alternating

3. *Afterimage* 17
   (1) Normal
   (2) ARC

4. Visuscope 18
   (1) Foveal
   (2) Parafoveal
   (3) Paramacular
   (4) Eccentric
   (5) Lost

5. *Amblyoscope*
   Correction 19
   (1) With
   (2) Without

   Far
   a. *Objective angle*—in 5 prism diopter steps 20
   (1) 1 to 5 d
   (2) 6 to 10 d
   (3) 11 to 15 d
   (4) 16 to 20 d
   (5) 21 to 25 d
   (6) 26 to 30 d
   (7) 31 to 35 d
   (8) 36 to 40 d
   (9) 41 to 45 d
   (0) 46 and over
   Orthophoria—blank column

   b. *Subjective angle* (Same as above) 21

   c. *Deviation* 22
   (1) ST
   (2) ST with LH
   (3) ST with RH
   (4) ST with DH
   (5) XT
   (6) XT with LH
   (7) XT with RH
   (8) XT with DH
   (9) Orthophoria with LH
   (0) Orthophoria with RH
   Orthophoria—Blank column

   d. *Vertical*—in 2 prism diopter steps 23
   (1) 1 to 2 d
   (2) 3 to 4 d
   (3) 5 to 6 d
   (4) 7 to 8 d
   (5) 9 to 10 d
   (6) 11 to 12 d
   (7) 13 to 14 d
   (8) 15 to 16 d
   (9) 17 to 18 d
   (0) 19 and over
   No vertical—blank column

   e. *Superimposition* 24
   (1) Stable
   (2) Unstable
   (3) Lost

   f. *Suppression*
   Group I 25
   (1) OD
   (2) OS
   (3) Alternates

   Group II 26
   (1) Foveal
   (2) Macular
   (3) Paramacular

   g. *Fusion* 27
   (1) Foveal
   (2) Macular
   (3) Paramacular

   h. *Fusional Amplitudes*
   Divergence 28
   (1) Excellent—13 B.I. and over
   (2) Good — 9 B.I. to 12 B.I.
   (3) Fair — 4 B.I. to 8 B.I.
   (4) Poor — 3 B.I. or less
   Convergence 29
   (1) Excellent—40 B.O. and over
   (2) Good —30 B.O. to 39 B.O.
   (3) Fair —19 B.O. to 29 B.O.
   (4) Poor —18 B.O. or less

6. *Amblyoscope*
   Near (Same as above) 30-37
   Divergence 38
   (1) Excellent—20 B.I. and over
   (2) Good —12 B.I. to 19 B.I.
   (3) Fair — 6 B.I. to 11 B.I.
   (4) Poor — 5 B.I. or less
   Convergence 39
   (1) Excellent—46 B.O. or over
   (2) Good —35 B.O. to 45 B.O.
   (3) Fair —19 B.O. to 34 B.O.
   (4) Poor —18 B.O. or less

7. *Scotomas of Suppression*
   a. *Method of Measurement* 40
   (1) Loose prisms and red glass
   (2) Amblyoscope
   (3) Lancaster red-green test
   (4) 1 and 2
   (5) 1 and 3
   (6) 2 and 3
   (7) 1 and 2 and 3

   b. Measurement in Diopters—5 prism diopter steps 41
   (1) 1 to 5 d
   (2) 6 to 10 d
   (3) 11 to 15 d
   (4) 16 to 20 d
   (5) 21 to 25 d

8. *Stereopsis* 42
Group I
(1) Wirt
(2) Verhoeff
(3) Stereoscope
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group II 43
(1) Amblyoscope
(2) Red-green lenses and Keystone red-green cards
(3) Housefly
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

9. *Grade of Stereopsis*—% 44
(1) 5
(2) 15
(3) 30
(4) 50
(5) 60
(6) 70
(7) 80
(8) 85
(9) 90
(0) 95 to 100

ORTHOPTIC TREATMENT

1. *Visual Acuity* 45
a. *Occlusion* 46
(1) Occluder
(2) Frosted or taped lens
(3) Elastoplast

b. *Office Activities*
Group I 47
(1) Localisator
(2) Corrector
(3) Drill
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group II 48
(1) Separation trainer
(2) Coordinator
(3) "E" charts at different distances
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

c. *Home Activities*
Group I 49
(1) Handcrafts
(2) Television
(3) Games
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group II 50
(1) Reading
(2) Follow-the-dot
(3) Other
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

2. *Disruption of ARC and Eccentric Fixation*
Group I 51
(1) Euthyscope
(2) Coordinator
(3) Amblyoscope
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group II 52
(1) Localisator
(2) Home Exercises
(3)
(4) 1 and 2

3. *Diplopia Exercises* 53
(1) Red glass diplopia
(2) Diplopia without red glass
(3) Physiological diplopia
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

4. *Superimposition Exercises*
Group I 54
(1) Amblyoscope
(2) Mirror superimposition
(3) Stereoscope
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group II 55
(1) Stereomotivator
(2) Hole-in-hand
(3)
(4) 1 and 2

5. *Anti-suppression Exercises*

Group I 56
(1) Amblyoscope
(2) Physiologic diplopia—all variations
(3) Bar framing
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group II 57
(1) Mirror superimposition
(2) Stereomotivator
(3) Cheiroscope
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group III 58
(1) Remy separator
(2) Red tracing
(3) Red reading
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group IV 59
(1) Walraven Bar separator
(2) Red glass and two-colored number
(3) Hole-in-hand
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group V 60
(1) Red-green lenses with red-green screen on T.V.
(2) T.V. Trainer
(3) Red-green lenses with red-green screen and white stencils
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group VI 61
(1) Worth-Black amblyoscope
(2) Stereoscope
(3) Orthofuser
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group VII 62
(1) Bar reading
(2) Tibb's binocular trainer
(3)
(4) 1 and 2

6. *Exercises to develop fusional range and endurance*

Group I 63
(1) Amblyoscope
(2) Stereomotivator
(3) Walraven bar separator and loose prisms
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group II 64
(1) Red glass and light
(2) Red glass and two-colored number
(3) Loose prisms
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group III 65
(1) Stereoscope
(2) Worth-Black amblyoscope
(3) Orthofuser
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group IV 66
(1) Bar reading
(2) NPC exercises with cardboard and pin
(3) Finger-to-nose
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group V 67
(1) Split cards
(2) T.V. trainer
(3) Red-green lenses and red-green screen
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

7. *Dissociation Exercises*

Group I 68
(1) Hole-in-hand
(2) Loose prism—base-in
(3) Remy separator
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group II 69
(1) Amblyoscope
(2) Blurring and clearing without correction
(3) Walraven bar separator
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group III 70
(1) Orthofuser
(2) Stereoscope
(3) Worth-Black amblyoscope
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group IV 71
(1) Bar reading
(2)
(3)

8. *Stereopsis Exercises*

Group I 72
(1) Amblyoscope
(2) Red-green lenses with Keystone red-green cards
(3) Stereomotivator
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Group II 73
(1) Stereoscope
(2) Worth-Black amblyoscope
(3) Orthofuser
(4) 1 and 2
(5) 1 and 3
(6) 2 and 3
(7) 1 and 2 and 3

Number of Visits 74-75

Handedness 76
(1) Right
(2) Left

ANOMALOUS RETINAL CORRESPONDENCE: A FIVE-YEAR SURVEY

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THE purpose of this paper is to give additional information regarding the use of a classification of anomalous retinal correspondence which was first presented in 1955.[5] It cannot add new information of a physiologic nature to the subject of anomalous correspondence. Neither can it take shape without quoting from some of the excellent papers already written by ophthalmologists and orthoptists.

It may, indeed, be regarded as a plea for more careful recording of the original status and end results of the treatment of anomalous correspondence over a period of years so that impressions and ideas gained in our offices and clinics can be substantiated and become mutually helpful.

In an earlier paper,[5] it was reported that because of geographical and time factors involved, the patients in whom anomalous correspondence was still present were dependent on occlusion and voluntary alternation exercises, rather than on intensive instrument work.

This situation still prevails at Iowa. Actual therapy sessions are reserved for cases in which normal retinal correspondence is established but fusional amplitudes are inadequate; for example, surgical cases (preoperative and postoperative), intermittent deviations (including accommodative esotropia), and convergence insufficiencies.

By definition, normal correspondence is present when corresponding retinal points or areas in the two eyes have a common visual direction. If the eyes are straight, there is single binocular vision or fusion. Misalignment of the visual axes gives rise to diplopia because of the stimulation of noncorresponding areas.

Anomalous retinal correspondence may be defined (1) as a condition in which corresponding retinal areas, especially the two foveas, acquire different visual directions; or (2) as a condition in which noncorresponding retinal areas acquire a common visual direction. This comes about as a sensory adaptation to a motor anomaly (deviation of the visual axes).

One cannot discuss anomalous correspondence without pointing out the discrepancy between the terminology used in England and that which is used here. I think I am correct in saying that the majority of orthoptists who receive their training in England prefer to classify patients as having either (1) normal correspondence or (2) anomalous correspondence or (3) lack of normal correspondence—those in the third group being potential cases of anomalous correspondence. Accordingly, in such a classification, only the patients dem-

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onstrating anomalous fusion with foveal sized slides are considered to have anomalous correspondence.

There would seem to be general agreement with Maurer,[6] who has stated that since anomalous correspondence is such a persistent condition and so difficult to cure, it is better to attempt to prevent its development.

Mayou[7] has pointed out that particular care must be taken in diagnosing anomalous correspondence in the presence of amblyopia, since in many cases the patient will obtain normal correspondence as soon as the visual acuity improves, and in esotropia with an accommodative factor, since the angle of deviation varies with the amount of accommodation and may give the appearance of anomalous correspondence when in fact, correspondence is normal.

Since we know that differences in terminology exist, we recognize the type of patient described by another orthoptist but we may hesitate to agree upon classification. For instance three different examiners may describe retinal correspondence existing in a particular case in three ways: (1) as lack of normal correspondence; (2) as negative anomalous correspondence; or (3) as either 4, 6 or 8 of the classification on which this paper is based.

When thinking in terms of the first description, it is difficult to see a real difference between "abnormal" and "lack of normal" correspondence.

In the second group, "negative anomalous" suggests denial of an anomalous condition and is therefore, confusing. In this paper, the issue is avoided by using numbers and a more detailed classification. The intention has been to simplify the correlation.

EXPLANATION OF CODE NUMBERS

1. NRC (normal retinal correspondence)—Fusion at objective angle
2. Supp. NRC—"Jump" at objective angle
3. Harmonious ARC—Fusion at zero
4. Supp. Harmonious ARC—"Jump" zero
5. Unharmonious ARC—Fusion between objective angle and zero
6. Supp. Unharmonious ARC — "Jump" between objective angle and zero
7. No subjective findings
8. No definite subjective angle; diplopia at objective angle
   ET-heteronymous
   XT-homonymous
9. Vertical ARC
10. No simultaneous perception

Regardless of differences in classification and in techniques used to attain our common goal, we welcome new ideas and appreciate the efforts of colleagues whose inquisitive minds keep us moving forward. In the final analysis we arrive at somewhat the same conclusions. I found very few cases in groups 3 (fusion at zero) and 5 (fusion between objective angle and zero). There were many more in the "suppression" groups, particularly in group 8, where the only information was "crossed diplopia at objective angle" (in esotropia) and "homonymous diplopia at objective angle" (in exotropia). To me this diplopia means that the two foveas have acquired different visual directions and anomalous correspondence prevails to some degree. If my classi-

fication of anomalous correspondence did not include the suppression groups, it would be much smaller.

The most important obstacle to overcome is suppression. Walraven[9] emphasizes the need for eradication of foveal suppression, reporting good results in 91 of 106 cases of anomalous correspondence. It would be desirable to be able to make a real comparison between results of "intensive treatment" and "treatment without benefit of intensive orthoptics, using instruments." This would necessitate the use of a common classification.

The method of treating anomalous correspondence as described by Tibbs[8] relies upon preliminary antisuppression exercises. Maintenance of foveal fixation is necessary throughout treatment. Tibbs considers that anomalous correspondence is present in nonaccommodative esotropia if the subjective and objective measurements are different. She warns us that there may be a variable shift on the major amblyoscope in accommodative esotropia which must not be confused with anomalous correspondence.

Fixation, central, steady and sustained, is of prime importance in both diagnostic and therapeutic procedures. As we become more proficient at gaining good fixation, "unknown quantities" become less.

With this in mind, an evaluation in our clinic includes instruction in either monocular fixation, alternate fixation with red glass over dominant eye, or awareness of proper diplopia within the angle of squint. Age readiness, of course, and some promise of binocular function are prerequisite to this evaluation. Any simple procedure which can be performed in the office and supervised by the parent is assigned as a home exercise to be done in addition to the prescribed occlusion until the time of the next evaluation by orthoptist and ophthalmologist. This has been very worthwhile and helps to offset the lack of intensive therapy in our clinic.

Knight[4] in her paper on "Orthoptic Variations" describes how progress was made in five out of ten cases of abandoning the attempt to gain normal correspondence in its strictest sense and concentrating instead upon improving amplitudes at the patient's subjective angle. In making the choice between treatment or nontreatment of anomalous correspondence, authorities do not always agree. When a patient has useful visual acuity in each eye, a fair cosmetic position and no symptoms, most ophthalmologists and orthoptists would consider this sensory adaptation of anomalous correspondence to be a satisfactory adjustment on the part of the patient, making interference by either surgical procedures or orthoptics unnecessary. However, where unstable factors are involved, it seems unfair to the patient to assume that a number of consecutive trial sessions will decide his prognosis for all time. Patients with an unstable retinal correspondence deserve periodic evaluations and guidance in order that we may fulfill the orthoptic aim of "the best possible use of the two eyes together."

The problem of when to treat and when not to treat anomalous correspondence was ably presented by Eustis and Ferguson.[3] Although their techniques and terminology regarding anomalous correspondence differed, each emphasized the need for a more precise selection of cases.

The need for research in orthoptics always has been one of Burian's major concerns.[2] Bryer has also pointed out the need for research in orthoptics.[1]

Nearly all of you must at some time have been faced with the almost hopeless task of finding time to do the necessary research to obtain proof for the ideas formed in practice. I should like to think that sometime in the near future one or more research establishments may be set up on a permanent basis—two or three orthoptists could be employed to do nothing but research—to gather material for statistical analysis in their area and assist with investigations throughout the country.

A basic requirement in accomplishing this end would be a much more standardized form of recording.

In an institution such as the State University of Iowa Hospital, there is great wealth of material. For the present study, a coding system has been developed since 1955 which is of use in recording and also offers an opportunity for orthoptic students to summarize their findings on each patient.

This code system enables us to select from our card file, cases in all categories ranging from accommodative esotropia to the more obscure "jaw winking." Other pertinent information (address, age, hospital number, etc.) is included to facilitate obtaining the patient's complete medical history when necessary. The time consumed in a survey of nearly 2,000 cases is tremendous. Patients certainly deserve all of our attention during office hours, but once the research project was begun we often found ourselves thinking, "If it were not for the patients, we could get so much more done."

An evaluation in our clinic consists of, briefly, general observation for such things as head tilt or epicanthus and the tests which are repeated at one-month to six-month intervals, in so far as age readiness and cooperation allow. They are:

1. Visual acuity
2. Worth 4-dot
3. Fixation—quality, preference, angle kappa, etc.
4. Versions
5. Measurement of deviation by (a) corneal reflection (Hirschberg, Krimsky), (b) cover tests, and (c) major amblyoscope
6. Near point of convergence—objective and subjective
7. Interpupillary distance
8. Status of binocular vision as tested on the major amblyoscope (including fusional amplitudes if any), diplopia test, stereoscope, polaroid fly
9. Status of retinal correspondence as tested on the major amblyoscope, and the afterimage test.

The results of these tests are recorded at each visit. However, only the retinal correspondence as determined on the major amblyoscope is reported in this survey (table I). Of the various tests, those employing the major amblyoscope more nearly simulate casual seeing and at the same time provide a controlled situation.

All heterotropia cases in which the patient made his initial visit after January 1, 1955, were tabulated. The first column indicates the age of the patient at the time of the first visit. The second column shows the distribution of the 1,850 patients in the different age groups.

Of the 1,850 cases, only 1,263 were included in the study because 587 had been evaluated only once and therefore lacked subsequent findings for

TABLE I

STATUS OF RETINAL CORRESPONDENCE
COMPARISON OF FIRST AND LATEST EVALUATION
HETEROTROPIA PATIENTS IN ALL AGE GROUPS
FIVE YEAR PERIOD (1955-1959)

AGE AT FIRST EVAL.	TOTAL NO. EACH GROUP	NO. PTS. WITH ONE EVAL. ONLY	NO. PTS. INCLUDED IN STUDY	STATUS OF RETINAL CORRESPONDENCE AT (A) FIRST AND (B) LATEST EVALUATION										
				CODE NO.	1	2	3	4	5	6	7	8	9	10
—2	131	29	102	A							102			
				B	20	11					63	7		1
2	147	32	115	A	4	1				1	104	4		1
				B	35	26		1	2	2	40	7		2
3	182	40	142	A	27	4			2		105	3		
				B	52	34			1		39	15		1
4	193	38	155	A	40	18		3	2	1	75	14		2
				B	68	32		1	3	6	23	17		5
5	168	47	121	A	34	17	2	1	4	4	51	8		
				B	58	30		2	2		15	11		3
6	132	32	100	A	35	13	2	1	4	10	21	13		1
				B	46	21	2	1	4	8	7	10		1
7	85	23	62	A	18	13	2	1	1	5	11	9		2
				B	30	16	1	1	3	2	1	3		5
8	90	26	64	A	27	8		2	2	4	8	10		3
				B	33	14		1	1	3	1	5		6
9	71	19	52	A	18	7	1		1	6	8	11		
				B	26	11	2		1	2	2	8		

TABLE I (CONTINUED)
STATUS OF RETINAL CORRESPONDENCE
COMPARISON OF FIRST AND LATEST EVALUATION
HETEROTROPIA PATIENTS IN ALL AGE GROUPS
FIVE YEAR PERIOD (1955-1959)

AGE AT FIRST EVAL.	TOTAL NO. EACH GROUP	NO. PTS. WITH ONE EVAL. ONLY	NO. PTS. INCLUDED IN STUDY	STATUS OF RETINAL CORRESPONDENCE AT (A) FIRST AND (B) LATEST EVALUATION										
				CODE NO.	1	2	3	4	5	6	7	8	9	10
10	49	21	28	A	11	5				3	4	4		1
				B	14	7				2	1	1		3
11	42	5	37	A	17	6		1	1	4	5	1		2
				B	17	7		2	1	2	2	4		2
12	30	14	16	A	7	2	1		2	1	2	1		
				B	7	3			2		2	2		
13-20	192	82	110	A	41	20	2	2	3	7	12	19		4
				B	53	24	1	1	2	1	8	12	1	7
20+	338	179	159	A	101	18				7	8	20		5
				B	107	15	1	1		4	10	14		7
	1850	587	1263	A	380	133	10	11	22	53	516	117	0	21
				B	566	251	7	11	22	32	214	116	1	43

1. NRC—fusion at obj. angle
2. Supp. NRC—"jump" at obj. angle
3. Harmonious ARC—fusion at zero
4. Supp. Harm. ARC—"jump" at zero
5. Unharmonious ARC—fusion between obj. angle and zero
6. Supp. Unharm. ARC—"jump" between obj. angle and zero
7. No subj. findings
8. No definite subj. angle
   Diplopia at obj. angle } ET—heteronymous / ET—homonymous
9. Vertical ARC
10. No simultaneous perception

TABLE II
AVERAGE NUMBER OF EVALUATIONS PER PATIENT

AGE AT FIRST EVALUATION	AVERAGE NUMBER OF EVALUATIONS PER PATIENT OVER PERIOD OF:				
	1 YEAR	2 YEARS	3 YEARS	4 YEARS	5 YEARS
—2	4	7	10	13	13
2	4	7	9	9	16
3	4	7	9	13	13
4	4	7	9	10	12
5	4	7	8	10	12
6	4	7	7	10	13
7	3	8	8	10	
8	4	6	9	12	8
9	3	7	7	10	
10	3	7	6	7	10
11	3	6	5	8	10
12	4	6	8		
13-20	3	5	7	6	
20+	4	5	5	6	5
	4	7	8	9	8

comparison. There are several reasons for this:

(1) Enough time had not elapsed since the first visit to warrant a second visit;

(2) Some of the patients were sent in only for consultation and then sent back to the referring ophthalmologist.

(3) Some of the patients, after obtaining information and advice decided to do nothing further about the condition.

(4) Some of the patients, especially in the older age groups, had undergone some surgical procedure for cosmetic improvement after the first visit and although they were seen postoperatively by the doctor, did not return to the orthoptic clinic to continue treatment by orthoptics.

The average number of evaluations per patient is recorded in table II. Occasional trial "series" in certain normal correspondence cases are not included here. The initial visit may have taken place any time between January 1, 1955, and January 1, 1960. In some cases all of the visits were in the same year; in others, they were distributed over two to five years. For this reason it seemed only fair to indicate the average number of visits per patient in each span of years as well as in each age group. For example, in the group of patients who were 5 years old at the first visit, those who came for one year only

averaged four visits during that year. Those who were seen over a two-year period averaged seven visits in that period of time. Likewise, the average was eight visits in three years, ten visits in four years, and twelve visits in five years. These figures did not vary as much in the different age groups as I would have predicted.

Distribution of Patients in Table I

Column 1 (under Status of Retinal Correspondence) contains the number of patients with normal correspondence in each age group. A substantial increase in this column is shown for the latest findings (under B). The greater increase is in the younger groups, as we would expect. You will notice that there was no increase in the 11-year-old and 12-year-old groups. Is it surprising to find normal correspondence so prevalent in the group of patients who were twenty years old or more at the time of the first visit? Perhaps not, when we consider that very few patients with early onset of squint would have delayed the first visit until adulthood. So it is reasonable to suppose that most of the patients in this age group have had intermittent heterotropia which became constant or have had an injury resulting in paralytic squint.

Column 2 (supp. NRC) really gives us concern. No angle of anomaly remains, yet there is persistent central suppression. In all age groups except the oldest (20+ years) there are more patients with suppression normal correspondence at the latest visit than were found in that category at the first visit. We like to think that many of these are in a transition period on their way to normal correspondence, but we know from experience that some patients cannot seem to get beyond this last hurdle. In this instance, it would be interesting to know how many such patients had been operated upon before a substantial diplopia awareness was gained. Unfortunately, we did not begin to code surgical procedures or orthoptic series until July 1958, and to search for this data in so large a number of medical histories was not feasible.

The small number of entries in columns 3, 4, 5, 6 shows the low incidence of fusion or "jump" at an anomalous subjective angle. I would have estimated a much larger number of such cases.

In column 7, where the predominance of "no subjective findings" is in the younger age groups, we know that advancing maturity will find many of them transferred to columns 1 or 2 because they are routinely being observed and occluded. The fact that a few in the older age groups never get beyond the stage of "no subjective findings" is explained by the considerable number of patients sent for cosmetic improvement from our state institutions. Another source of surprise for me was the number of children 5 and 6 years old who did not respond subjectively at the first visit. I would have given credit for more cooperation in these groups.

If we had not worked so hard with the patients recorded in column 8, some of them would have been in column 7. If we could have worked longer and harder, they might have been distributed in columns 3, 4, 5 and 6. The finding of anomalous diplopia with wide separation of images at the objective angle places these patients in an anomalous correspondence category, at least until

the elusive subjective angle can be captured by antisuppression maneuvers.

Column 9 is notable for its blank spaces. When starting our coding system, we thought we would find vertical anomalous correspondence on the troposcope and this *was* found in one patient in the age group ranging from 13 to 20 years.

Column 10 needs no explanation. Obviously, deep amblyopia is a common finding in this group. There seem to be more amblyopes in B than in A. Perhaps, through the years, we have become more discerning.

In summarizing the interest and concern which prompted this bit of research, I would like to quote Burian[2] in dealing with the question, "Why do we bother with anomalous correspondence?"

> We cannot deny that it is of greatest interest to those to whom the theory of binocular vision presents a real challenge. However, this is not a sufficient reason for the practicing ophthalmologist to occupy himself with this somewhat obscure and much debated phenomenon. As I see it, the practicing ophthalmologist will have two questions in his mind in connection with anomalous correspondence. One question is whether it is an obstacle to binocular vision about which something ought or ought not to be done therapeutically; the other is whether it is a condition which may interfere with surgical success.
>
> I would answer the first question by saying that the majority of ophthalmologists who have had sufficient experience with orthoptics to be competent to pass judgment feel that anomalous correspondence is a serious obstacle to binocular vision which should be removed and can be removed in a large number of patients. However, there are a few no less competent men whose experience has been that, while anomalous correspondence is indeed an obstacle to binocular vision, the result of the treatment is so unsatisfactory that it is not warranted.
>
> These discrepancies in the results are doubtless due to the classification adopted by those reporting their results. As I have stressed before, in addition to a scientific definition of anomalous correspondence, we need a clinical definition and classification on which the majority of men interested in this field can agree. Only after such an agreement has been reached can comparable statistical data be developed.
>
> The outcome of these studies should then also answer the second question of whether or not anomalous correspondence adversely influences the end result of surgery for squint.

Surely every orthoptist has her own ideas regarding classification and results of therapy in cases of anomalous retinal correspondence. It remains for us to make a more organized and concerted effort to pool our findings. If this paper brings forth statistics and constructive criticism leading to more effective screening and well-chosen therapy, it will have served its purpose.

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ONE HUNDRED AND FIFTY CONSECUTIVE CASES OF STRABISMUS

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THE purpose of this paper is to discuss and review 150 consecutive cases of strabismus occurring in the private practice of one ophthalmologist, a staff member of the University of Alberta Hospital in Edmonton. Originally this review was planned to include a number of cases of adult squint, both concomitant and paralytic, but it was decided that orthoptists would find it more interesting and instructive if we confined our attention to 150 consecutive cases of concomitant strabismus in children.

This group of cases will be compared to 230 consecutive cases reported by Schlossman and Shier[5] in 1955, 483 selected cases by Cooper[2] in 1955, and 40 odd cases selected at random by Dolores Engel.[3]

Sixty-three of the children in this series were boys and 87 were girls. The age at onset is an important factor in strabismus, but it was not obtainable for 30 of the children, as a number of the patients in our study were from foster homes and others were Indian and Eskimo children not accompanied by their parents. In the remaining 120 patients, strabismus was recorded as appearing at the age of one year or before in 50 of the children and between the ages of one and five in 56 children. There were 14 children in whom the strabismus was reported as appearing after they were five years old. Wheeler stresses the importance of the age of onset as a factor in choosing the method of treatment.

The strabismus was related to a definite precipitating factor in only 21 cases. Ten children showed a history of illness or injury at the time of onset, and in eleven children heredity was an apparent factor. Schlossman and Priestley[4] believe heredity to be an accountable factor in 47 per cent of all cases of strabismus.

Thirty-eight of the 150 children had a divergent type of deviation and 112 had a convergent deviation. The percentages represented by these figures—25 per cent were divergent and 75 per cent convergent—are comparable to those of Cooper,[2] who, reporting from a series of 483 cases of strabismus, found 21 per cent were divergent and 79 per cent convergent.

Of the 112 children with convergent strabismus, 58 had unilateral fixation and 54 had alternating fixation; 17 had pure accommodation, 45 had mixed accommodation and 50 had only a small amount of accommodation or none at all. Fusion was present in 37 patients and absent in 75 patients. Thirty-two of the 112 patients had amblyopia, of whom 12 had eccentric fixation.

Considering the group with onset up to one year of age from the point

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of view of treatment, there seems to be an increasing tendency to early surgical correction. Prolonged attempts at other types of treatment seem eventually to end in surgical correction and as Wheeler has suggested, an early operation may avert the development of abnormal retinal correspondence, may reduce the incidence of amblyopia, and may prevent secondary changes occurring in the extraocular muscles.

In the older age groups, refraction and accommodation are of greater importance. Correction of the refractive error, the use of miotics, the use of occlusion, and orthoptic treatment are all helpful to varying degrees. Those who have a residual deviation despite the use of these medical means are candidates for surgical correction.

The divergent cases have been arbitrarily divided into groupings of divergence excess, convergence insufficiency, and those with approximately the same angle for distance and near. The mixed group is slightly larger than either of the other two. In regard to the divergent cases, it has been our observation that those patients who have phoria at an early age will in time develop a definite tropia, and those who already have definite tropias will gradually increase their angles of deviation, no matter what type of medical or orthoptic treatment is instituted. It is, our routine practice to correct myopia and astigmatism fully and to undercorrect hyperopia. As far as orthoptics is concerned, antisuppression exercises are emphasized. Convergence exercises are rarely used because in our experience, active convergence exercises prior to surgical intervention may be responsible for postoperative esotropia. Therefore, we confine our orthoptic approach almost exclusively to antisuppression exercises.

In our area these cases are usually operated upon when the child is between the ages of two and four years, and the surgical correction is usually symmetrical. If postoperatively a gross undercorrection is present, further surgical intervention is necessary. If a mild undercorrection has resulted, antisuppression exercises stressing vergences, together with minus three spheres and base-in prisms, may be effective. A mild early postoperative overcorrection is quite desirable. Should a moderate overcorrection be apparent, Floropryl, orthoptic treatments and bifocals may be helpful in overcoming it. In these cases it is important to develop a technique of "stalling" for the so-called "tincture of time;" "studied neglect" will often effect a satisfactory cure. In those rare cases in which gross overcorrection has resulted, the stalling technique may not be feasible, as the parents are displeased that their child is now crosseyed. In those infrequent cases, reoperation becomes necessary.

As to the management of purely accommodative squint, we have followed Wheeler's suggestions. We divide those patients whose eyes are straight with glasses into two groups: (1) those with a refractive error of less than a +4.00 sphere with a +1.50 cylinder and (2) those who require a greater correction in order to relieve the deviation. In those requiring less than a plus 4 sphere with a +1.50 cylinder, conservative surgical intervention has often been the procedure of choice. Wheeler states that in this group postoperative secondary divergence is not likely to occur. Certainly in many of these cases we are influenced by other factors. If the parents do not object to glasses

on their child, and if the patient will wear them without complaint, then this is the treatment recommended. If, however, the parents are extremely unhappy because their child must wear glasses, and if great difficulty is encountered in getting the patient to wear them, then we consider the possibility of surgical correction.

The presence or absence of fusion and the incidence of amblyopia and eccentric fixation were mentioned earlier. Relative to these two factors, I would like to repeat the principles proposed by Costenbader.[1] In the treatment of strabismus, the goal is the best possible vision in each eye, the best possible binocular alignment with harmonious movements, and the most secure single binocular vision. It seems essential that these aims must continually be kept in mind, and that every effort must be made to obtain these three qualities of good vision, good alignment and good binocular vision.

It has been our experience that of these three objectives good cosmetic alignment is the easiest to accomplish. Unfortunately, many ophthalmologists seem to be satisfied if the eyes are straight. We consider this to be strictly a "head in the sand" approach. The role of the orthoptist in regard to good vision and good binocular vision is essential. Every effort should be made to develop and improve the fusional ability. As far as amblyopia is concerned we are convinced that total occlusion is basic. Much has been written about psychological trauma associated with total occlusion and because of this and other factors many have had a tendency to settle for intermittent patching. In our experience, if we have explained the situation to the parents so that they understand the purpose of the treatment, they will cooperate. Our problem is rarely with the child, but often with parent; but if the parent is relatively intelligent, little difficulty is encountered. It is essential that the parents understand the purposes and aims of total occlusion. If no improvement has been demonstrated after using occlusion for the standard test period of six weeks, we do not persist, but if beginning improvement is apparent, we will pursue this course for months. In cases of eccentric fixation, restraint must be used because of the possibility of reinforcing the eccentricity. In such cases, patching the deviating eye for a month may be helpful in breaking up the eccentricity. Pleoptics should eventually increase our facility in treating these cases.

SUMMARY

An approach to the treatment of concomitant squint, drawn from experience with 150 cases of consecutive concomitant squint, has been reviewed. The importance of the age of onset has been stressed in regard to the choice of treatment and particularly as to the wisdom of early surgical intervention. It is our feeling that divergent cases all progress, and that early surgical intervention is indicated.

The basic objectives of treatment are good visual acuity in each eye, good alignment of the visual axes, and good binocular function. The ophthalmologist and the orthoptic technician should work together to accomplish these objectives. The importance of surgical re-alignment, the value of orthoptics for the development and improvement of fusional abilities, and the necessity of intensive and persistent treatment of amblyopia when

it is encountered, are factors in treatment which have been considered.

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BLINDSPOT ESOTROPIA

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A PROBLEM of particular interest is presented in those patients with the so-called blindspot esotropia. These patients use the physiologic blindspot of the deviating eye to avoid diplopia. The rays of light from the fixation object fall upon the optic nervehead of the deviating eye, thereby making suppression to avoid double vision unnecessary. The amount of deviation will be from 25 to 35 prism diopters, and there may be a coexisting vertical deviation as large as 10 prism diopters. The deviation may be inconsistent, at times being at the blindspot measurement for one distance but not for another. It may also be a blindspot esotropia with correction but not when glasses are off, or vice versa.

There are two types of blindspot esotropia. The differential diagnosis between them is made on the basis of the presence or absence of sensory abnormalities.

The blindspot mechanism with sensory abnormalities, or the "coincidental" type is a condition in which the image of the fixation object is projected onto the blindspot. This usually occurs when the deviation is between 25 and 35 prism diopters. This group is associated with such sensory anomalies as abnormal retinal correspondence, amblyopia, deep suppression, or a combination of any of these. The prognosis for this group is much poorer than in the type without sensory anomalies.

The diagnosis and treatment of the blindspot mechanism is the same as for any esotropia with sensory anomalies. When the abnormal retinal correspondence or amblyopia has been eliminated, the treatment subsequently follows that for the second group of blindspot esotropia.

The blindspot mechanism without sensory abnormalities, or the so-called "blindspot syndrome," is an adaptive type of blindspot esotropia. When there is an esotropia of small to moderate degree with annoying diplopia and without sufficient divergence to regain bifoveal fixation, the motor response tends to move the eye farther to the esotropic side, projecting the image onto the blindspot, thus giving the patient single vision. The patients in this group have no sensory anomalies such as deep suppression, amblyopia or abnormal retinal correspondence. Since these are not present, this group offers excellent opportunity for the establishment of comfortable binocular single vision following correction of the motor anomaly. Fair fusion potential will be shown on the major amblyoscope. There may be occasional diplopia or confusion of images in casual seeing, due to the slight variability of angle which causes the image to fall outside the blindspot at times.

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DIAGNOSIS

Deviation

The amount of deviation on prism and cover measurement will be from 25 to 35 prism diopters with a possible vertical component up to 10 prism diopters.

Red Glass Test

The red glass test will show "suppression," either of one eye or alternately, the image of the fixation object falling on the blindspot of the deviating eye. This seeming "suppression" may be overcome by inserting a 10 diopter prism base down over one eye, thus causing the image to fall outside of the blindspot, where the diplopia may be measured, by finding the strength prism necessary to bring the two images into a vertical line, one directly above the other.

Lancaster Red-Green Test

The Lancaster test is done as follows: Seated one meter from a blank wall, the patient is given a green flashlight. The examiner uses a red flashlight and projects the red light on the wall directly before the patient, asking him to fix the red light constantly. He is then instructed to project the green light over the red. This preliminary procedure is to give him an idea of what he should do in the test. He is then given red-green spectacles, and is instructed again to place the green light on the red. (We usually have the red lens over the right eye for convenience and consistency in the mechanical performance.) The examiner stands behind the patient with his head directly above the patient's head. By closing his left eye and fixing the right light with his right eye, the examiner will find that as the patient places the green light on the red, the green light will disappear, since it is falling on his (the examiner's) blindspot. This test may be done with either eye fixing, the light held by the examiner determining the fixing eye.

The Major Amblyoscope

On the major amblyoscope, the angle will be consistent with the prism and cover measurements. Fusion and some amplitude will be demonstrated with little or no suppression.

TREATMENT

Glasses

The patient should be given the proper plus correction to allow clear vision and minimum esotropia at 20 feet. He should have bifocals if the accommodation - convergence accommodation (AC/A) ratio is abnormal.

Miotics

Miotics should be used for a trial period to lessen the deviation and cause the image to fall outside the blindspot if possible.

Occlusion

Occlusion should be alternated to try to lessen the deviation by relieving the blindspot relationship.

Orthoptics

The development of vergences is very important prior to surgical correction of a deviation, in order that the patient will have enough reserve of convergence and divergence to

overcome any residual esotropia. If this reserve is not attained before the operation, any residual deviation will tend to increase until the patient is again using the blindspot. The patient with postoperative diplopia and the inability to obtain single vision in any other way, will eventually develop a blindspot esotropia again.

If the patient is not within a few diopters of orthophoria following surgical correction of his deviation, he will require postoperative orthoptics to develop a greater amplitude of fusion. Bifocals or miotics may be useful in reducing the accommodative effort until the fusional mechanism stabilizes. Antisuppression, red-glass diplopia, physiologic diplopia, recession, amblyoscope training and the Tibbs binocular trainer are all helpful in developing comfortable binocular single vision and in preventing regression to blindspot esotropia.

CASE REPORTS

1. *J. C. (age, 11 years)*

History:

Onset E(T) several years before first visit, with glasses at age 10 years (+4.00s +0.50 x 90 O.U.).
Had no exercises or occlusion.

November 12, 1956:

V.O.D. cc, 20/20; V.O.S. cc, 20/20
ET cc, 20; ET sc, 25
ET′ cc, 25; ET′ sc, 25
Red-glass test cc: alternate suppression distance and near (with vertical prism ET 25—blindspot esotropia)
Lancaster red-green test: blindspot esotropia
Major amblyoscope: ET 30 objectively and subjectively. Fused third degree targets and had stereopsis. Suppressed O.D. with foveal targets.
Treatment: Occlusion O.S. and orthoptics

January 1, 1957: (following 9 sessions of orthoptics to improve vergences, and occlusion to break down blindspot pattern)
V.O.D. cc, 20/20; V.O.S. cc, 20/20
Red-glass test with correction: homonymous diplopia of 25 prism diopters in primary and lateral fields (mostly alternate suppression; measured while using vertical prism)
Major amblyoscope: ET, 22-24 objectively and subjectively
Fair to good foveal fusion; no suppression
Divergence to +18; convergence to +30
Treatment: Surgical correction

January 22, 1957: Recession medial recti O.U. Following operation there was a small intermittent E(T) for distance and X(T) for near. Occlusion with periodic checkups for four months, then patient was put on orthoptics. Five sessions of exercises, including diplopia training, framing, fusion, and recession.

June 23, 1958:

V.O.D., 20/25-1; V.O.S., 20/25-1
E(T) sc, 4; E c +1.00S = 4
Ortho′ E c −1.00S = 4
E(T)′ c −2.00S = 6
Relative divergence, 2/0; relative convergence, 8/6
Relative divergence′, 6/3; relative convergence′, 12/9
Major amblyoscope: E 8 objectively and subjectively, diplopia with foveal targets and fused third grade targets with stereopsis. With peripheral targets diverged to zero, converged to +14
Wirt stereopsis test: 80 per cent
Patient has kept the same findings for the past year—no symptoms and no complaints

2. *W. H. (age, 8 years)*

History:

Onset E(T) just before end of school (was transferred to new city and new school with much emotional upset). Patient was conscious of diplopia when eyes turned in, which was disturbing to him. First seen five months following onset.

November 13, 1954:

V.O.D., 20/15; V.O.S., 20/15
Refractive error: +0.75S O.U.
ET 20 Distance
ET′ 35 <—— ET′ 35 ——> ET′ 25 Near
Red-glass test: alternate suppression distance and near (with vertical prism: ET 20 and ET′ 35—blindspot esotropia)
Lancaster red-green test: blindspot esotropia
Major amblyoscope: ET 20 objectively and subjectively; confusion with fusion targets
Treatment: Alternate occlusion and orthoptics

June 15, 1955: (following 11 orthoptic sessions, including diplopia training, fusional amplitude, traceograph)
V.O.D., 20/20+; V.O.S., 20/20+
ET = 10-12 <—— ET 12 ——> ET = 14
ET′ = 18-25
Major amblyoscope: ET 8-10 objectively and subjectively; macular and foveal fusion; little suppression with peripheral targets; diverged to +4; converged to +14.

June 16, 1955: Resection both lateral recti
Following operation ET was 2-4 and ET′, 8-18.
Constant occlusion and orthoptics did not improve vergences much. DFP was used. Strabismus gradually increased to ET 15 and ET′ 20-30 with normal retinal correspondence. Very little or no amplitude at final visit before second operation. Blindspot esotropia at near with Lancaster red-green test.

April 19, 1957: Recession right medial rectus
Following operation ET was 6-16; ET′, 20-30 with good vision and normal correspondence.

June 18, 1957: Recession left medial rectus
Following operation ET was 6 and ET′ 8 with very little amplitude of fusion. Gradually reduced with orthoptics to E(T)′, 2-4 and X 4 with fair amplitudes. Has been checked periodically with periodic sessions of orthoptics. For past two years has had no treatment.

April 10, 1959:
V.O.D. with correction, −1.50S 20/20+;
V.O.S. with correction, −1.75S 20/20—
Ortho cc, E′ cc 4
Red-glass test: fusion, distance and near
Worth 4-dot: fusion, distance and near
Wirt stereopsis test cc: 15 per cent; good stereopsis with Wirt fly card
No symptoms and no complaints from patient.

SUMMARY AND CONCLUSIONS

1. There are two types of blindspot esotropia: (a) blindspot mechanism with sensory abnormalities, and (b) blindspot mechanism without sensory abnormalities, the latter more commonly known as the blindspot syndrome. The differential diagnosis is determined by the presence or absence of the sensory abnormalities.

2. Emphasis is placed on the importance of adequate surgical correction, and on preoperative and postoperative orthoptic treatment to build up sufficient vergence reserve and thus prevent the re-establishment of blindspot esotropia after surgical correction.

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CURRENT CONCEPTS AND TREATMENT OF AMBLYOPIA

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AMBLYOPIA has always been something like the weather. Everybody talked about it but no one did much about it. Twenty years ago the climatologist relied on the Indian rain dancers to change the weather, and the eye specialists had to rely upon occlusion as the best weapon against amblyopia. Modern seeding techniques have replaced those Indian rain dancers in the past two decades, and advances in theory and therapy have given new hope to the ophthalmologist in the treatment of amblyopia.

Through the years our knowledge of the physiology of amblyopia has slowly increased, yet for two hundred years the original method of treatment by occlusion has stood the test of time as the single outstanding method of improving the vision in those patients not benefitting by glasses or surgical intervention. Of course, there have been many modifications of the original occlusion technique as originally advocated by de Buffon,[4] but in one way or another the success of these methods depends upon the depression of the vision of the better eye, thereby motivating the use of the poorer eye.

Amblyopia may be defined as decreased vision which cannot be explained by organic pathologic changes. Careful examination of the ocular media and the visible conduction system with the slit lamp and the ophthalmoscope must reveal only normal findings, even though objective examination of the eye evidences no pathologic state. It is possible that retinal hemorrhages, present as the result of an arduous delivery, may have caused irreparable damage to the macular region. Such hemorrhages are not uncommon under these circumstances, as has been noted by Kauffman.[7] Means of uncovering this subclinical pathologic condition will be mentioned later. Strictly speaking, any optically corrected vision below the level of 20/20 may be included in the diagnostic category of amblyopia.

Estimates of the incidence of amblyopia vary from 2 per cent in Switzerland to over 5 per cent in England. In the United States, the combined results of three separate surveys on 75,000 draftees and military personnel gave an incidence of 1.9 per cent. This incidence is comparable to my findings in 6,000 school children whom I have seen in the past two years as the consultant in ophthalmology for the San Francisco Health Department. Amblyopia remains as a leading cause of preventable blindness despite increased awareness of the problem, with its attendant earlier diagnosis and treatment.

Suppression may be facultative, that is, present only when the op-

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posite eye is in use, or obligatory, where it exists even when the opposite eye is occluded leading to amblyopia. We are particularly interested in the obligatory group. With these patients it is possible to demonstrate a relative scotoma on the tangent screen even in mild amblyopes if a small enough test object is used. In more marked amblyopes, an absolute scotoma may be demarcated at the point of normal centric fixation. The suppression area may vary in size between individuals from two to ten degrees.

Guibor[5] has postulated that amblyopia begins in esotropic infants as an accommodative spasm with variable suppression. With the passage of time, the suppression becomes deeper and more constant and a distinct central scotoma develops. If treatment is not instituted at this time, an eccentric fixation may develop. Of course strabismus is just one cause for amblyopia. Marked refractive errors or a marked monocular refractive difference (anisometropia) are other common etiologic mechanisms. As a matter of fact, from the figures of Sugar,[8] who studied two hundred consecutive cases of amblyopia, it is interesting to note that 76 per cent of the nonstrabismic patients had an anisometropia of 1.5 diopters or more; and even among those with strabismic amblyopia, anisometropia was present in 29 per cent.

The habit patterns of the entire body are being established during a child's younger years. The ultimate patterns which are accepted are those which on the basis of trial and error prove to be the most satisfactory for the special and particular needs of the child. During this adjustment period, the functional development of the visual apparatus is in a state of flux, just as are the psychological adaptations which will produce the basic personality makeup of the child. In my opinion it is not possible to state flatly that after a set age (six years, for example) the eye cannot develop better acuity. That is to say, the period of flux varies considerably from one child to another. For example, I have occasionally seen a child at the age of eleven years respond quite well to occlusion by patching. Though it is generally accepted that an amblyopic eye may, with proper treatment, regain the level of acuity which it had reached during the development years, these cases did not seem to represent a reestablishment of previously attained vision.

In some anisometropic patients it is possible that there is not actual suppression present in the defective eye, since visual stimulus is so slight. These amblyopic patients then would be in contrast to those who have regressed from partially developed vision after they have accepted active inhibition as the solution to a visual conflict. After the period of flux is over though, no matter what the age may be, the visual acuity is permanently established and there can be no uniocular regression of vision.

Since the diagnosis of amblyopia rests primarily upon the visual acuity, it is important that precise measurements be obtained and that the method used be recorded. We have all had patients who scored higher when tested with the illiterate E than when tested on the regular Snellen chart. Certainly the chances of guessing are better when there are only four possible answers, but since frequently the individual letters are shown, another variable is also included. Thus, recently a number of observers have commented upon the differences be-

tween their findings when isolated letters are presented and when an entire line of letters is projected. Testing the individual letters has been called *angular vision*, and the linear testing has been referred to as *cortical vision*. The latter terminology in my opinion is a misnomer, since both methods rely on the brain cortex for visual appreciation. I have no quarrel with the term *angular acuity*, but why not call the testing of letters in a line just what it is, namely *linear acuity?*

Though there is ample room for discussion, it is the opinion of most neurophysiologists that the cortex rather than the retina is the site of the basic defect in amblyopia. Proponents of both sides are willing to accept, however, that the process which impairs acuity is one of inhibition. For example, supporters of retinal inhibition note that pupillary reactions are decreased when the macula is stimulated in amblyopic patients in contrast to increased pupillary contractions when the macula of the normal eye receives light stimulation. Harms[6] has concluded that the inhibition must be in the synapses of the retina, since the pupillomotor fibers leave the visual pathway below the cortex.

Not all the observations substantiating the retinal site have been reduplicated, but Bietti[2] in Italy has shown that certain topical drugs placed in the conjunctival sac have improved vision in amblyopes. He holds that the drugs act directly upon the retina, increasing the sensitivity at the retinal synapses. The preponderance of evidence favors central inhibition. Not only is the electroretinogram normal in amblyopes, but certainly, more significantly, the electroencephalogram is abnormal, according to Burian and Wesley. With this conflicting evidence it is quite possible that there is primary inhibition at the cortical level and retinal inhibition under cortical influence.

Though light and color perception are essentially normal in the amblyope, the form vision which represents a higher developmental stage is diminished. But even the form vision of an amblyope can compare favorably with that of the normal person when tested under scotopic (decreased illumination) conditions. Since amblyopia with suppression is an adaptive reaction to a visually confusing situation, it is understandable that suppression is not necessary and apparently not developed for scotopic vision, since acuity is diminished and binocular confusion less likely. Studies by Von Noorden and Burian have shown in essence that normal eyes show a large drop in acuity with decreased illumination;[9,10] on the other hand, strabismic amblyopic eyes retained approximately the same vision. It is interesting that fixation improves in the dark-adapted amblyope, but this is not the explanation for the remarkable visual findings. Amblyopia in strabismic patients, then, is a selective suppression of the form sense of visual acuity under photopic conditions, with such suppression being a necessary adaptation to a binocular conflict.

It would be interesting to know what the photopic to scotopic visual differences might be if this same group of strabismic amblyopes were compared with amblyopes who have anisometropia but no ocular muscle imbalance. It is possible that some differences might be found, since some of the anisometropes may not actually be suppressing.

Not all amblyopes will limit their sensory pathology to central inhibition however. An area outside the suppression area may have greater visual acuity as long as the suppression is existing, and the patient may use this area as a false macula. These patients then have developed eccentric fixation. The greater acuity found at the edges of the scotoma may account for the wandering and unstable fixators, but it is strange that in many cases a definite preferred site of fixation may be selected. The consistent selection of this one area for fixation can be measured by special ophthalmoscopes developed for this purpose. The area may be several degrees away from the fovea, well beyond the region of suppression, and in a position which has less vision potential than adjacent areas which are closer to the fovea. (The vision potential follows a gradient of declining acuity away from the fovea.) Factors other than a desire for better vision must be at work then. One likely explanation for this eccentric fixation was advanced by Bielschowsky, who felt that with prolonged stimulation of the noncorresponding points, the deviating eye will assume its new visual direction even when that eye is used monocularly. Thus, though slightly better visual acuity might be obtained in another area of the retina, prolonged stimulation of the strabismic eye finally developed a spatial localization ordinarily associated with the fovea. Bielschowsky's explanation does not give insight as to why some patients have eccentric fixation which is not in conjunction with their type of deviation.

Thus we can classify amblyopes as centric fixators, whose sensory problem is primarily one of suppression or possibly with lack of stimulation to learn, or as eccentric fixators, who have in addition to central suppression, compounded their sensory anomalies by giving a new visual direction to an area outside of the fovea.

Earlier the estimates of amblyopia in our population were mentioned. The incidence of eccentric fixation has been considered low even recently by some ophthalmologists. However, through the current interest in the condition and better diagnostic instruments it has become apparent that this complication of amblyopia is more common than was ever suspected. With only a few notable exceptions among eccentric fixation patients, standard treatment for amblyopia has been worthless for this group. As has been noted by others, occlusion of the better eye only serves to reinforce the anomalous fixation, making matters worse. Undoubtedly some of our past therapeutic failures have been eccentric fixators whose eyes have been occluded with adverse effects.

In treatment of amblyopia, the patients must be separated into two groups at the outset, since the approach will of necessity be quite different.

Not much new can be added to the conventional therapy for centric fixation amblyopia. In conjunction with correction of refractive errors, occlusion, and indicated surgical treatment, the orthoptist may be called upon to devise procedures which will motivate the patient's desire for better vision. Each orthoptist develops her routine of promoting interest in detailed projects and games so that suppression may be eliminated. The television set, which has been blamed by many parents as the cause of their children's refractive problems, has actually enhanced the results of our patching.

As for the occlusion itself, I feel that there should be no halfway measures here. Occlusion should be total, with an elastoplast occluder which should be removed only by the parent for cleansing and rebandaging. The patient should not use his better eye even when the patch is changed. Patching should be continued until such time as one month's treatment results in no visual improvement.

Partial occlusion procedures, such as rubber suction cups on the glasses, nail polish, or permafilm occlusion of the lens, or cycloplegic drops, are not preferred in the initial treatment of amblyopia. They should be used only when necessary for psychological reasons, because of tape allergies, or to maintain preference for the treated eye during the concluding phases of treatment. Please note that the new treatment of eccentric fixation soon to be discussed has definite, though limited, applicability to centric fixators also.

As has been indicated, treatment for eccentric fixation has almost always been quite unsatisfactory and discouraging. It was in 1743 that de Buffon[4] first described the use of occlusion as the treatment of choice for amblyopia. It was two hundred years later before medical progress was able to provide another significant specific therapeutic method for amblyopia. In the 1940's two European researchers, Bangerter and Cüppers, first reported successful treatment of eccentric fixation by new and what might even be referred to as revolutionary methods.

Bangerter of Switzerland conceived the term *pleoptics* to designate these methods utilized in therapy of amblyopia. The techniques of the two men, though certainly not identical, do have similarities. Since there have been extensive recent reports on the instruments used by these men, a brief discussion of that aspect only is in order now.

Cüppers of Germany uses four uncomplicated and relatively simple instruments. Two of these instruments are ophthalmoscopes, one of which is the visuscope, the other the euthyscope. The visuscope is a diagnostic instrument used by the examiner to project a cross onto the retina. The patient is instructed to look at the cross, and if the fovea does not move away from the cross, fixation is centric. If the patient does select a site of fixation away from the fovea, a series of concentric rings may be projected onto the retina which will measure the amount of eccentricity in degrees. The second ophthalmoscope, the euthyscope, is strictly a therapeutic device. With it the therapist can stimulate the site of fixation with a moderately bright light. Because there is a black disc in the center of the projected beam of light, a ring of light strikes only the retina; and the macular region is spared stimulation. An afterimage is thereby induced which can be seen more distinctly when the patient looks at a white-silver screen. For success, the patient must be able to perceive a negative afterimage, that is, a dark ring corresponding to the fatigued or stimulated outer area, and a white or clear center corresponding to the unstimulated area of the macula. The patient is taught to place the clear area onto succeedingly smaller individual letters or on a magnetized target which can be fixed to the screen. The target is held in place by a magnet beneath the screen. The use of the magnet in fixing the target offers the advantage of variability of position. The afterimage is reinforced by a flashing light which is controlled by an alternator box which can accurately regulate the duration of the flashing light and

the dark periods in between. Early in the treatment it is necessary to have longer periods of light upon the screen because the afterimage is not well retained. Also early in the treatment it is necessary to give the patient several flashes of the usual 15 to 30 second duration, but later it may be possible to see the afterimage for a half hour on the basis of one flashing and proper adjustment of the alternator. Along with this treatment the patient is placed at a small viewing box, the coordinator. The patient is instructed to look at the clumps of whirling bands of light. These clumps look a bit like a revolving airplane propeller and should be localized by the observer behind the fixation target, which is affixed to the screen. If the light is not seen behind the target, the patient is looking at the target with his eccentric area. If the patient can see no whirling light at all, macular disease is most probable. This is true because the polarized light of the coordinator can be appreciated only by the fovea because of the architecture of the cells in this area. The subject first practices localization, and later advances to hand and eye coordination exercises by placing a pointer upon the images which he is seeing centrally. This is difficult at first, but it is all part of the reorientation of the eye to establish the proper relationship of the fovea to objects in space. There are other instruments, such as the space coordinator introduced by Cüppers and used to aid in proprioceptive development as a final phase in the treatment.

Bangerter carries out his treatment in a different fashion. Whereas the aforementioned treatment of Cüppers limits the amount of light stimulation to the eccentric area and gives none to the centric area, in the technique of Bangerter, the eccentric false macula is dazzled by a very bright light. This dazzling takes place for one minute while the central area is occluded. Then while the pseudo macula is occluded, the fovea is given fifty to one hundred short flashes with light or optotypes, followed finally by a second brief dazzling stimulus to the eccentric fixation area. This is all done on an instrument somewhat resembling a slit lamp and known as the pleoptophor. Unlike the other technique, which occludes the preferred eye during office treatment, the patient looks at a fixation target in the pleoptophor with his better eye while the examiner carries out the treatment to the eccentrically fixing eye. Bangerter starts his proprioception training early and a number of ingenious instruments have been designed to give aid to the spatial reorientation by utilizing the senses of touch, hearing, vibration and memory.

Any technique which is designed to treat eccentric fixation must accomplish two things: (1) give the fovea its normal sense of position in space, and (2) re-establish the fovea's normal physiological visual superiority over the abnormal eccentric area. The Cüppers method is excellent for the first goal inasmuch as the afterimage has the psychological qualities of a real object in space, but there is some doubt as to whether any significant effect on the fovea's relative acuity is obtained by the afterimage. The direct stimulation technique of Bangerter "blinds" the perimacular region. It would seem that this should assure a relatively more perceptive fovea, at the same time aiding in the treatment of the agnosia, since work on the localizator is done immediately after pleoptophor therapy.

Cüppers and Bangerter both feel that the first step in treatment is to occlude the eccentrically fixing eye for about four weeks to discourage active inhibition before the specific treatment is started. The amblyopic eye is kept occluded between therapy sessions until such time as the patient has demonstrated ability to maintain fixation centrally and vision has improved. Then the patch is transferred to the dominant eye.

A number of authors have stressed the error of patching the good eye when eccentric fixation exists. By and large this is a wise admonition, but as with many rules, there are exceptions. When a child is less than 6 years old or seems to be visually immature, it is sometimes possible to break up the eccentric pattern merely by patching the centric eye. These youngsters are still in a state of flux, and many are still able to return to centric fixation in this new situation. The active inhibition of the fovea is a conditioned reflex. By removing the trigger mechanism (the diplopia caused by the better eye), the eccentric eye may no longer find reward by suppressing. It is particularly true that the child who has wandering fixation may respond to occlusion, since in this case the false visual direction is unstable.

Success with amblyopic patients who are centric fixators has been reported by both groups. Theoretically at least, Bangerter's regime should be better, since with its direct stimulation it seems to have a physiological advantage in the awakening of central acuity.

It is possible to evaluate prognosis for success by several factors including the ability to appreciate a negative afterimage, an appreciation of Haidinger's brushes, a lack of marked disparity between the angular and linear visual acuity, and no significant difference in visual acuity between visions obtained under scotopic and photopic conditions. In addition, if the patient is not showing good progress between the fifth and tenth visit, then treatment should be discontinued. The prognosis decreases with age; nevertheless, successful results have been reported in patients over the age of twenty. With proper consideration of these factors and after all pathologic causes have been ruled out, there is still one very important facet to evaluate. That is the patient's motivation. Aside from the obvious desire to have better vision, it will also be influenced by his intelligence, parental support, emotional stability, economic and geographic status. Finally, before undertaking the lengthy treatment (up to forty visits), the professional personnel involved must be prepared to follow through with orthoptics, surgical correction and other treatment as indicated. As for the binocular status, the very least we must obtain is alternation. Without this the eccentric fixation may return and the work will have been for naught.

As regards our ultimate goal in the treatment of amblyopia of any type, Wheeler[11] has pointed out that the binocular fixation pattern is important, since marked preference for one eye will permit the successfully treated eye to regress once monocular occlusion is stopped. Our goal of normal binocular vision will likely be thwarted if there is a significant preference for one eye. His point is well taken, and the elimination of one-eyed preference should be included in our criteria for evaluating the success of our amblyopia therapy.

It was noted earlier that the use of topical drugs relieved inhibition, presumably at the retinal level. Bietti[2] has carried this work further by using strychnine orally and has obtained promising results, particularly in centric amblyopes, in nonsquinting anisometropes, and in patients with good angular acuity but poor linear acuity. Even hypnosis[3] has been used to free the patient from his suppression with some apparent success.

In conclusion then, it may be said that amblyopia occurs for the most part as an active inhibition of the form component of vision. This is considered to be a selective suppression under cortical control, though there may also be secondary local retinal inhibition. It does not seem logical to me that amblyopia in nonstrabismic anisometropes would require inhibition in all cases.

The new regimes introduced by Bangerter and Cüppers show promise, particularly in amblyopia with eccentric fixation. Both techniques have their advantages, though there is a dearth of reports giving proper evaluation of Bangerter's work, since his equipment has just recently been made available and is so expensive. The fact that the latter's methods are more adaptable to the treatment of young children at an age when they are more likely to be in a state of flux, as opposed to the minimum age limit of 6 years in the Cüpper's technique, to me is quite significant.

It is apparent that amblyopia as we know it is passing out of the dark age and that our knowledge of physiology and therapy is accelerating. Treatment now involves a knowledge of clinical anatomy of the retina, training in the use of new and costly instruments, utilization of topical and systemic drugs, and time, which is expensive for all concerned. Let us not forget that "an ounce of prevention is worth more than a pound of cure." Early recognition followed by prompt treatment is the most important single factor in the cure of amblyopia.

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PLEOPTICS: BANGERTER'S METHOD OF TREATMENT

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THE purpose of this paper is to summarize Bangerter's theories and methods of pleoptic treatment.

Bangerter classifies amblyopia as follows: (1) *pure amblyopia*—poor visual acuity without any detectable lesions; (2) *relative amblyopia*—amblyopia with an organic lesion which is not so marked as to account for the poor vision (this second category includes *myopia, nystagmus and other organic lesions)*. The development of amblyopia may take the following course: *Amblyopia of arrest*—the interruption of postnatal development of visual function at any level. Amblyopia of arrest may be subdivided into (a) *residual amblyopia*, which is the portion of undeveloped visual function, and (b) *inhibition amblyopia*, which refers to the inhibited part of visual function already developed. This part can be restored at any time without great difficulty.

Etiologically, the causes of amblyopia can be classified into two groups: (1) *inhibition of visual development*, caused either (a) by obstacles such as ptosis, opacities of lens, or refractive anomalies which cause a blurred image on the retina, or (b) by congenital squint resulting from a motor disturbance in one or more of the muscles so the eye cannot be brought into the normal straight ahead position, or (c) by suppression to prevent diplopia; and (2) *inhibition of visual function*, which is considered an active inhibition originating from the desire of the individual to rid himself of diplopia, and which refers to continuous exclusion of vision already developed.

The early discovery of amblyopia contributes to a better prognosis. The potentiality for developing visual function after birth decreases gradually during the period of growth. With this in mind, a pamphlet is given to young mothers in the babies' hospital informing them to watch their child's eyes carefully during the first formative months.

TREATMENT

During the first and second years of life, not much actual treatment can be undertaken but certain prophylactic measures can be of value.

1. Refraction under cycloplegia to rule out high refractive errors or anisometropia.

2. The use of atropine in the fixing eye to blur it in an attempt to stimulate the deviating eye to take up fixation. This is tried for a three-week period with weekly checks to see whether any progress is being made. It has proved successful in many cases.

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3. If alternate fixation can be developed, it is maintained by the use of alternating atropinization. A printed form explaining the treatment is given to the parent, and instructions are made clear on how this is done. Alternate patching is advised as soon as glasses can be worn.

4. "Sneak" or slowly increasing occlusion is also practiced. It consists of graded lens paper pasted on the eyeglass, which blurs the vision in the good eye anywhere from 20/25 to less than 20/200. The purpose is to put the good eye at a disadvantage in order to help the weak eye in its competitive struggle. The best response to this type of occlusion is obtained in children between the ages of 2 and 3 years. Prerequisites to "sneak" occlusion are that there is no fixed eccentric fixation and that the child can be sufficiently supervised. If the response is good, the occlusion of the good eye is rapidly increased to complete occlusion; if progress is slow, the occlusion is increased slowly. Occlusion is changed over to the poor eye if any tendency toward persistent eccentric fixation is found.

5. If fixation is central, occlusion of the good eye is indicated.

In the child between the ages of 3 and 5 years, the effect of the treatment with atropine and "sneak" occlusion is considerably diminished if amblyopia with eccentric fixation has been present for any length of time. The child is still too young for intensive pleoptic training, but if there are therapeutic measures which will improve chances for obtaining good vision in the future, they should be carried out. The most important factor is the type of fixation. If we are dealing with a case of central fixation, the vision will be improved by patching the good eye. If we find an eccentric fixation, patching of the good eye is contraindicated. Because of the central scotoma, the fovea has never been used, therefore it is not able to take up fixation and we are apt to reinforce the eccentric area. Chances for improvement are better if we cover the poor eye totally over a period of approximately four months to protect it from any light stimulus. Depending on the density of the scotoma, there may be a change in fixation to a searching movement over the central area, at which time there is no harm in patching the good eye and forcing the poor one to take up fixation. While doing this, it is important to examine the patient weekly. Any tendency toward a fixed eccentric fixation should be stopped immediately by patching the poor eye again.

A trial training period to determine whether there is a chance for successful treatment may be undertaken when the child nears the end of his fifth year. Postponement of treatment may be necessary for one year or more depending on the child's development. The years from three to five are troublesome, since no real treatment can be given.

Most effective results are obtained during the period from the sixth to the ninth year. Every effort is made to complete the cure during this time. Progress may be hindered by lack of cooperation on the part of the child, and the technician must be resourceful and skilled to make him want a better eye.

After the ninth year the responsiveness to correction of amblyopia of early arrest is considerably lessened. This may eventually be compensated for by very active cooperation on the

part of the patient. Age should not keep us from an intensive trial training, especially if the good eye is in danger.

Pleoptics for amblyopia with eccentric fixation is only effective if intensive; at least once a day for one hour but preferably twice a day. At Bangerter's clinic, the patient undergoes treatment for a period of three or four weeks. During this time he either stays at the hospital or lives in St. Gallen, making daily visits to the clinic.

Before actual treatment is undertaken, the poor eye should be patched for at least a month. A prognosis is made before training is started. It is based on a thorough eye examination and the case history. Factors contributing to a good prognosis are, a low refractive error, the youth of the patient (ideally around seven years) and the absence of an organic lesion or some hereditary factor.

Bangerter's method of treating amblyopia with eccentric fixation consists of the combined dazzling-stimulating procedure which is carried out at the *pleoptophor*.[3] The area of eccentric fixation is dazzled with bright light and then intermittent light stimuli are directed at the fovea to break down the scotoma. There are two stencils used with this method; one of them has a central cover to protect the foveal area during the dazzling, and the other has a small central opening to expose the foveal area in the stimulating phase of treatment.

The treatment on the pleoptophor is passive and not dependent on information from the patient. It can therefore, be easily used with the young child. Another advantage is that the amblyopic eye is brought into the position desired by the good eye fixing constantly a target which is movable in all directions and appears to be at infinity. The guiding target can be adjusted for any refraction.

Eighteen times magnification and a large field allow good observation of the fundus. By doing only the first phase, the application of the afterimage is also possible. The effect of the dazzling-stimulating treatment lasts for about ten to fifteen minutes, during which more training is carried out on the localizer and various other instruments, depending on the case. The dazzling-stimulating procedure is always done before the exercises at the various instruments are performed. Two instruments of value in the treatment are the *localizer* and the *corrector*.

The localizer helps to establish central fixation by combining various principles: (a) *coordination of the hand and eye;* (b) *shifting of concentration to foveal area by means of light stimuli;* (c) *conscious correction of the principal visual direction with the help of simultaneous vision.* The *corrector*, also aiming towards correct coordination, utilizes hand and eye coordination with the auditory senses.

Optotypes are not shown before the fixation can become central at least momentarily. Unsteady parafoveal to central fixation may be treated on the *centrophore*, which is so constructed that in the middle of a rotating spiral (which has a great stimulating effect on the retina and literally draws fixation to the center), single optotypes or words can be shown for near as well as for distance.

Separation difficulty due to the confusion of the retinal area used for fixation is a leading characteristic of amblyopic vision. The visual acuity when tested with single optotypes is better than when taken with whole lines. With this special difficulty in mind, Bangerter built the *separation trainer*. It consists of twenty-five separate optotypes which can be turned in various directions and separated from each other by varying distances. While the patient is reading them, starting with the largest separation, they are gradually brought closer together until there is no space left between them.[1]

It is understood that the poor eye is patched again as soon as the hour of training is over. When fixation becomes central, the good eye is occluded and binocular orthoptic training is started.

In order to maintain the restored vision, the coordination of the two eyes by surgical treatment and by orthoptics is very important. The *synoptophore* is used in breaking down abnormal correspondence, and in stimulating simultaneous perception and fusion.[3] As soon as the patient is able to fuse at the objective angle, surgical treatment should be carried out.

The goal is binocular vision for distance and near. In cases of high anisometropia, organic lesions or difficult muscle imbalance, this ideal of binocularity may never be attained. Even in the absence of binocularity, the development of useful vision in the amblyopic eye is most valuable, should the dominant eye ever be impaired.

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OCCLUSION OF THE AMBLYOPIC EYE IN CASES OF ECCENTRIC FIXATION

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Occlusion of the amblyopic eye in eccentric fixation was begun in 1953 in patients with a gross eccentric fixation. This treatment was based on the theory that removal of the visual stimuli from the total retinal area would eliminate the positive visual response from the eccentric area and the negative inhibitional response from the macula. If this could be affected, presumably the child would be able to fix centrally with the amblyopic eye, making the development of central vision possible by the usual method of occlusion of the good eye to enforce use of the amblyopic eye.

There was some foundation for this theory. Swenson had reported success with occlusion of the temporal area only. Also a patient seen at Boston City Hospital Clinic had shown an improved visual acuity and establishment of central fixation after a parent had occluded the amblyopic eye by mistake.

Early results in our clinic seemed promising, and this method was used also for patients with an indefinite fixation or lack of fixation, if the effort to fix showed any tendency toward an eccentric area.

It should be noted that this study was undertaken prior to the development of the visuscope as a precise diagnostic instrument. The gradual changes in methods over seven years, the variations in procedures, and the extreme youth of the majority of patients, make evaluation of the data difficult.

Since 1953 we treated 70 patients by occluding the amblyopic eye prior to occlusion of the good eye. Initial vision has varied from no visual response to 20/100. During this same period, 56 patients with the same range of vision were treated by occlusion of the good eye only. Fourteen patients received no treatment for various reasons. Thus, half of the amblyopic cases seen were considered to have a fixation pattern that was more eccentric than central, as tested by the means available.

Angular visual acuity was tested by a single letter "E." Fixation was tested grossly by monocular and alternate cover tests, and on the troposcope, monocularly and with both eyes illuminated at the approximate squint angle (with reflexes centered on the two eyes) and with tubes in the parallel position.

The test which seemed to differentiate the patients most clearly was the response at the objective angle on the troposcope; that is, when stimulation was bimacular. Invariably, the patient with true eccentric fixation was aware of both images, in

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crossed position, when stimulation was bimacular. As soon as the light was removed from the good eye, the amblyopic eye deviated inward to fix on an eccentric area. When eccentric fixation was rigid and a visual response from this area had been obtained on other tests, a visual response was obtained from the eccentric area. In cases in which the eccentric area used by the patient corresponded with the angle of squint, there was no movement to fix at zero or parallel setting on alternate flashing.

In the majority of cases of indefinite fixation, the same binocular response was obtained bimacularly. When the light was removed from the good eye, the amblyopic eye deviated inward to fix, but immediately lost the image so that there was no visual response from the eccentric area. Awareness of the image which was before the amblyopic eye could be regained only when bimacular stimulation was given again. None of these patients were able to rotate outward to give a monocular visual response with tubes at zero.

In cases that were considered not to be eccentric, the patient either was able to obtain a momentary central fixation monocularly, after giving a binocular response bimacularly (usually crossed diplopia), or gave no indication of vision either monocularly or binocularly, and eye movements were wandering. If he could fix momentarily with central fixation, monocularly he could do this at zero setting as well as at the angle of squint.

The amblyopic eye was covered with an elastoplast occluder, which the patient was expected to wear constantly during waking hours. The length of time the occluder was worn by the 70 patients varied from one week to eight weeks. Thirty patients wore the occluder for two weeks, and 13 wore it for three weeks. It was worn by 2 patients for one week; 9 patients wore it for ten days; 6 patients wore it for four weeks; 1 patient for seven weeks; 1 patient for eight weeks. In 4 patients the length of wearing time was unknown as occlusion had been authorized by the referring doctor and carried out in his office.

At first, the patch was changed to the good eye for total occlusion only when central fixation was established and an improved vision recording had been obtained. Later, progress seemed to be more rapid if occlusion of the good eye for one hour daily was included in the regime of otherwise constant occlusion of the amblyopic eye as soon as any change in the fixational ability of the amblyopic eye was noted. In most cases, total occlusion of the good eye could follow after ten days to two weeks on the basis of an established central fixation and improved vision recording. In only three cases have we had to go back to occlusion of the amblyopic eye because central fixation did not seem to hold during occlusion of the good eye. This defection appears to have been due to the fact that total occlusion was not maintained on the eye, and the periods when no patch was worn caused a reversion to the previous fixation pattern. This does not seem to occur if the patch is worn over the amblyopic eye during such times as the child will not tolerate it on his good eye.

In recent cases, the child's activities during the hour of occlusion of the good eye have been limited to looking at pictures and attempting to identify

TABLE I

VISUAL IMPROVEMENT IN AMBLYOPIC PATIENTS TREATED WITH OCCLUSION OF THE AMBLYOPIC EYE PRIOR TO OCCLUSION OF THE GOOD EYE (A) AND THOSE TREATED WITH OCCLUSION OF THE GOOD EYE ONLY (B)

ANGULAR ACUITY	A	B
20/20	17	10
20/25	12	13
20/30	6	7
20/40	1	2
20/50	3	7
20/70	5	2
20/80	5 (1 incomplete)	4
20/100	4	1
20/200	4 (2 incomplete)	0
No improvement	8	8
TOTALS	65	54

them in decreasing size, holding the picture material close enough to the eye to be within the range of his ability to fix centrally.

Findings in 65 patients that were interpreted to indicate a change in fixation pattern are presented below. The relative number of cases in each category is indicated.

1. Eighteen patients showed the classical finding, an obvious shift from the eccentric to the central area (as indicated by gross change in position of the Hirschberg reflex, with movement outward to fixate when good eye is covered; this occurred also on the alternate cover test, and on the troposcope) with an improved angular visual acuity. This second recording showing improved acuity does not indicate visual development. It indicates that the patient is able to fix on a different retinal area that has a higher visual potential.

2. An alternation from eccentric to central fixation or from central to eccentric, with fixation not maintained steadily on either area was apparent in 7 of the patients.

3. In 7 patients momentary central fixation with loss of only the image and searching movements was demonstrated.

4. Three of the patients had central fixation only at near (6 to 13 inches from nose).

5. Central fixation on outward rotation only was present in 2 patients.

6. Change in eccentric area used for fixation towards the macula occurred in 2 patients.

Four patients could not be classified; 9 showed no change, and 13 were seen only after occlusion of the good eye had been started.

Fifty-seven patients obtained central fixation by these gross tests. Of these, 4 reverted to eccentric fixation; 3 were still under treatment, showing some tendency to revert during occlusion of the good eye (table I). Eight cases were not improved. One case which had shown no change in fixation pattern after occlusion of the amblyopic eye, responded to standard occlusion of the good eye.

This improvement in visual acuity has not been maintained in all cases, but the loss appears to be due to failure to maintain total occlusion of the good eye over a period of time long enough to stabilize vision.

A comparison of results of the cases treated with occlusion of the amblyopic eye prior to occlusion of the good eye and those treated with occlusion of the good eye only showed slightly better results in the former series. The average length of total occlusion of the good eye to attain these results was nine weeks in the first group; eleven weeks in the second group.

Although members of both groups had an initial vision of 20/100 or less, the two groups were found not to be comparable. In cases tending towards eccentric fixation, 56 patients had a visual acuity recording of less than 20/200, 5 patients had an acuity of 20/200, and 4 patients had 20/100 vision.

In cases with central fixation, 23 patients had a visual acuity recording of less than 20/200, 8 had 20/200, and 25 had 20/100.

There were no significant differences in age of onset, duration of the amblyopia, or refractive error. Very few cases in either group showed a significant anisometropia.

SUMMARY

None of the patients showed adverse effects from occlusion of the amblyopic eye. When used in later stages of treatment along with occlusion of the good eye, it seemed to prevent the regression of vision and fixation that occurs if occlusion of the good eye is not maintained totally. It was found that cooperation of the patient is obtained more easily with occlusion of the amblyopic eye first. The child gets used to the discomfort of the patch before he is handicapped visually.

The majority of patients in our series were 4 years of age or younger, and it is possible that many of those who were 2.5 to 3 years old could have obtained central fixation with occlusion of the good eye only. On the other hand, in all but 12 of these cases checked at the clinic, definite fixational changes were observed before the patch was changed from the amblyopic eye to the good eye.

It is possible that some of the patients assumed to have central fixation were not fixing foveally. This would account for the failure of many to reach 20/20 angular visual acuity with occlusion of the good eye only. With a few exceptions, the angular visual acuity of 20/20 was equivalent only to 20/50 morphoscopic visual acuity, i.e., when tested on a row of letters, in both series.

Early age of onset and duration of amblyopia appeared to be the greatest deterrents to development of visual

acuity. Achievement of binocularity, alteration, or long occlusion to stabilize vision are necessary for maintenance of the acuity achieved. Since these patients are least likely to achieve binocularity or even alternation, long occlusion will be necessary in most cases.

Where visual loss occurred in those cases treated by occlusion of the amblyopic eye, the vision did not drop to its previous low level, and in almost all cases, fixation remained central.

CONCLUSION

It would seem advisable to first occlude the amblyopic eye in patients with eccentric fixation. In addition to those individuals with gross eccentric fixation, all patients with vision of less than 20/100 should have initial occlusion of the amblyopic eye particularly when there is reason to question the diagnosis with the visuscope because of the age of the patient or lack of cooperation.

AN ORTHOPTIC TECHNICIAN DISCUSSES A PRACTICAL APPROACH TO THE ORTHOPTIC PATIENT

DOROTHEA MADAIRE
ONTARIO, CALIFORNIA

THIS paper will deal with my method of teaching children with defective vision the basic steps in learning to use both eyes at the same time. I have found it necessary to give them some idea of how eyes are supposed to work—and of how their eyes differ in this respect.

When I entered orthoptic training in early 1945, I was fortunate to have as teachers four different technicians. At that time there were more or less regular meetings of all the technicians in the District of Columbia area to discuss various problems met in daily work with patients. One of the main questions was: "How do *you* get your patients off the instruments?" This made quite an impression on me, for I was just learning how to use these instruments! That summer, at a regional meeting in Boston, I was impressed by Julia Lancaster's application of physiologic diplopia. I soon found that the patient himself must do the necessary work in obtaining and maintaining single binocular vision.

At my initial interview with the child, I sit down facing him and start to talk about eyes in general. I ask him how much he knows about how his eyes are supposed to work. This generally leads to his telling me how his eyes work, either from personal observation or from what he has been told by others. I often learn that the patient is more keenly aware of his problem than I would expect. This knowledge helps to lay the groundwork for the home exercise pattern.

I then tell him that I am going to give him a short course in how eyes work. His mother may listen, of course, but I am trying to teach him. He will see that he must learn for himself just as he does in school. This is very important, for his mother and I can only help him to get his eyes working right—the job is his. I have found that talking directly to the patient is important psychologically; he listens more attentively, since we are talking about his particular problem.

I tell him there are three ways to use our eyes (counting them off on my fingers): (1) using both eyes together perfectly; (2) seeing double; and (3) using one eye at a time. I tell him that this last one which is called *suppression* is especially important, because this is the one that we will have to work on. I ask the child to repeat the word so he will know it by sound when we learn what it is.

I explain that in a sense, everyone sees everything twice, once with the right eye, once with the left eye. Really, we do not "see" with our

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eyes; we "see" with our brain. Our eyes are just like cameras; they take the picture which, instead of being transferred to a film, is carried back to the brain, right now, so we see *at once*. Since we have two eyes, two pictures are taken at the same time. Well, how do you suppose we get one picture when our eyes have taken two? The child doesn't know, but he may try to guess. I let him talk a bit, then tell him how it really is.

I ask him if he knows what a "bull's-eye" is. Most children do, but if he does not, I draw one for him on some scrap-paper. I tell him, the back part of your eyes, the part that takes the picture, is just like a bull's-eye. The pictures received at the same place on the center of each bull's-eye "go back" to the same place in the brain and are then treated as if there were only one picture. It is just as though there were two roads, one from each eye. The roads are the same length, the little pictures get started at the same time, and so they reach the same place in the brain at the same time. This is "seeing perfectly."

"Now," I tell him, drawing a picture of his eyes, "these are your eyes." If the child has an esotropia, I turn one eye in a bit so that he can see how his eyes are, and that the pictures cannot be taken at the same place by the two eyes. Then I tell him what happens:

This eye (indicating the straight one) is taking the picture properly. This one (indicating the turned one) cannot take the picture at the right place, so it takes a picture to the side of the center of the bull's-eye. Both pictures start back to the place in the brain, and this one (indicating the straight eye) gets to the right place, but this one (indicating the turned eye) gets to the wrong place. The brain sees two different pictures, and that is why you "see" double. The brain does not like that, and it has discovered a third way to "see." We will talk about that, too.

We have a review. I ask:

If you are using both eyes together, you will see one of whatever you are looking at, right? (He agrees.) If one eye is turned, you will see two of whatever you are looking at, right? (He agrees.) Now, there is a third way to see, remember? That way is the one called "suppression."

So we start all over again, using the drawing of the two eyes with one eye turned as his is turned.

Now we are taking two pictures, but one is in the wrong place. The straight eye sends the picture back where it belongs. The turned eye sends the picture back but it does not hit the target. This picture often gets a late start, too, which makes it harder to get there on time. Sometimes this second picture does not get to the brain at all. It starts out, but it comes to a "roadblock" and is kept from going on; it has to stop, right there. We are talking about this roadblock when we say "suppression." We know the turned eye did its share by taking the picture, the road did its share by starting the picture back. We do not know how the roadblock got there, but it did and we will have to get rid of it. That is one reason I want you to know how your eyes work. You see, you are the only one in the whole world who can break down the roadblock, because it is your brain that is doing the seeing. I can tell you what to do, but I cannot tell you how because there is only one person who can use your brain.

The child will generally agree, and from then on it is a simple thing to get the answer to the question, "Who is going to make your eyes straight?" We repeat the word "suppression" again. If the child is old enough to understand or is troubled by diplopia, I tell him that sometimes the eye stops looking before it turns, in which case he does not see double. If the eye turns before it stops looking, he will see double. If he is interested, I demonstrate with the drawing.

Practically the same routine is used on the troposcope, encouraging the child to see both eyes, seeing separately with simultaneous perception target, perfectly when fusion is obtained at the angle of squint, double when the images separate, and suppression when he loses a check-mark. If a child cannot obtain diplopia, I show him the targets separately, calling attention to the check-marks especially, and he will see that he cannot get a perfect picture unless he does use both eyes.

At this point the child can understand some of the things I have been telling him. It is not difficult to maintain his interest, since we are talking about him. I am often amazed at his complete interest in trying to grasp what he has been told; this naturally helps in ensuing visits. He also makes more of an effort to tell me exactly what he sees—even to one-eyed diplopia, which is often a matter of great interest to a child.

I then take up the first step in home exercise (with most patients, that is). While this is all fresh in the child's mind, I teach him to use physiologic diplopia. I have a gadget called a framer, which I put on the child's head and show him that one eye sees one "stick," the other eye sees the other "stick." If he looks at me and not at the "stick," he will see two "sticks"—"The eyes are both using the right place to see with and the pictures are going to the right place, remember?" He usually does, and asks me how he can get two "sticks" if the eyes are straight. I use the bull's-eye again, showing him that the picture (or image, with the older child) is being taken on the center, the "stick" is being seen on the side, temporally, of each bull's-eye. I draw the "stick" for him and show him with my hands how it works. This is the best way I know of to get him to understand. (Of course I do not show him this until I am sure that he does "frame"!) This approach is used in explaining all the home exercises that I assign.

The parent is given the paper that lists the exercises, after being shown thoroughly the way to do them. I tell the child that his mother is now the orthoptist, and I am only going to check the work done at home. Again, this puts the burden on the patient.

There are two ways that you can be helped by other people. One is with glasses, the other is by surgical correction (if the child has already had an operation or is being prepared for one). The third way is to help yourself, which is what I will try to teach you to do. I really cannot tell you *how* to use your eyes, I can only tell you *what* to do.

If a child asks me why one eye is stronger than the other, I usually tell him to show me both hands. I ask him to tell me which hand *looks* stronger and he will generally show me the hand he uses most. Then I can point out to him that the top of that hand looks a little bit bigger than the top of the other hand, and that is because he uses it more. The same is true of the eyes; the one he has been using is the stronger one.

There are many other things that are discussed during this initial visit, depending on the interest stimulated in the patient. I try to answer these questions in words that he will understand, as I have indicated. I try to use uncomplicated illustrations familiar to the child in everyday life to clarify each point. Better orthoptic results may be achieved if the child understands some of the problems involved in binocular use of the eyes.

READING RETARDATION

DOROTHY JANZING
KENT, WASHINGTON

MOST children eagerly await the day of attending school, and it is certainly a vital and enriching experience in their young lives. They anticipate this new experience with great excitement, and their efforts are usually rewarded with successful learning. Unfortunately there are some children who are unable to make average progress in reading and writing. It has been said that as high as 20 per cent of the children in American classrooms have reading difficulties, and the University of California reports that 50 per cent of the top 20 per cent of their students regularly fail the English entrance examination. Reading retardation is common among juvenile delinquents. The inability to read will range from complete failure to understand the meaning of graphic symbols to merely slowness in learning to read and write.

The ophthalmologist is one of the first to be consulted to determine whether the child's failure to learn to read is due to poor vision or some other cause. The orthoptist, whose role is primarily concerned with phorias, tropias, suppression and amblyopia, will in the course of her duties, see many of these children with reading difficulties. It is important that she distinguish the orthoptic problem from the reading difficulty. Many will have no significant eye problems, and of course the ones that do must receive correction. However, even with correction the reading problem may persist. If we can become better informed about this field, we will be able to help parent and child by passing on our knowledge.

Considerable research is being done in the field of reading retardation and school screening programs. It is a field of great interest to educators, psychiatrists, psychologists, neurologists, and ophthalmologists. It is a field that is noted for its maze of terminology. Some of these terms are *congenital word blindness*, *dyslexia*, *congenital alexia*, *strephosymbolia* or *specific language disability*, and *congenital symbol amblyopia*. Many of these names reflect the etiologic views of their authors and herein lie many arguments among the various interested fields. I am not qualified to dispute their theories, but as orthoptists we should be aware of these theories and have some understanding of such theories as the psychology of perceptive and conceptual development as well as an adequate understanding of the child's failure to learn to read. Miller, in a paper given at a symposium on reading problems at the Eye Section of the Washington State Medical Association, quotes Rabinovitch and his associates in their definition of reading retardation as a level of reading achievement two years or more below the mental age as obtained on performance tests. In their analysis of two hundred and fifty cases they found three major groups: (1) organic, (2) primary reading retardation—those children who appear to have a defect in the capacity to

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integrate written material and to associate concepts with symbols, and (3) secondary reading retardation in which the inability to read is not related to any defect in basic reading capacity. These children seem to have a normal potential for reading which has been interfered with by factors such as anxiety and emotional blocking.

Differentiation between the primary and secondary types is difficult, but if therapy (psychotherapy or remedial reading) is to be successful, it is vital that the diagnosis be accurate. Various testing methods revealed that the two groups followed certain patterns. In the study of the two hundred and fifty cases it was found that the members of the primary group were most concerned over their inability to read; whereas in the secondary group, the emotional problems took precedence over their failure at reading. The primary group seemed to have specific language disabilities, such as very poor conceptual language in concepts involving time, order, size, number, and direction. They had trouble maintaining left-right direction, recognizing letters, reversing letters and words, and in many cases the auditory response was so poor that the patients could not express themselves orally even though the intellectual potential was very high. These problems were not present in the secondary group, which responded well to psychotherapy. A sympathetic remedial reading teacher can do much to help the emotionally disturbed child whose reading problem is only a part of the whole educational retardation. However, the child in the primary group cannot be treated for emotional problems alone, for these may be aggravated by frustration at his inability to read. The reading therapist will have to take into consideration the child's poor conceptual responses, the laterality problems and the visual and auditory difficulties.

Many methods are in use, and the approach to the problem varies. The Dyslexia Clinic in Chicago, which is a privately endowed clinic, uses the "complete approach." The child is seen by pediatrician, ophthalmologist, neurologist, social worker, psychologist and psychiatrist. He receives individual attention. This is probably the ideal situation, but unfortunately there are not enough of these clinics to care for the great number of retarded readers.

Locally, the University of Washington has a remedial reading clinic which serves a real need in the community. Some school districts are carrying on some sort of remedial program, but they are handicapped by a lack of trained personnel. I have observed that the teaching methods for specific language disabilities are contrary to remedial reading methods, which start from large wholes and proceed to small elements. The method for specific language disabilities begins with single letters or sound units, synchronizing the use of visual, auditory and kinesthetic channels of learning and leading to the recognition of larger units.

The interest being given to this problem in many professional fields indicates that more research is needed, with liason between the disciplines and their areas of interest. The teacher, the psychologist, the medical scientist, the sociologist, and the family unit are included.

The treatment of reading retardation is not an orthoptic problem, but orthoptists should be well informed on this subject in order to be of the best service to the child with reading problems and to his parents.

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PUBLIC RELATIONS

Good public relations are of increasing importance to the orthoptic technician. This is true in her contacts with patients and ophthalmologists, as well as with the public in general. As in any profession, one should convey an impression of intelligence as well as kindness and personal concern for the individual.

Proper public relations require that we as orthoptists recognize that our role in medicine is auxiliary. An orthoptist may be of great assistance to the ophthalmologist in the management of motility problems, but she must not consider herself a practitioner of medicine in any phase. Whenever possible, the orthoptist should work in proximity to the ophthalmologist either in the clinic or in his private office. Such a close working arrangement will lead to the effective treatment of orthoptic patients.

The future of orthoptics requires that we inform the public in general, as well as our own patients, as to the nature and purpose of this profession. More qualified young women must be attracted to orthoptics as a career. Talks before civic organizations, mothers' clubs or PTA groups may serve to publicize orthoptics to interested groups. A down-to-earth approach is essential, with the use of simple terms understandable to the layman.

Let us each strive to give orthoptics the best in public relations.

MARY D. HEMPSTEAD
President, AAOT

THE AMERICAN ORTHOPTIC COUNCIL: ITS PAST AND PRESENT

After twenty-three years of existence, it does not hurt to recall some of the past and present problems of the American Orthoptic Council.

When the American Orthoptic Council was first formed, largely through the efforts of Dr. LeGrand H. Hardy and Miss Elizabeth K. Stark, the chief problem was one of properly examining and qualifying those few orthoptic technicians who, through their own hard labors and the efforts of interested ophthalmologists, were trained in orthoptics. The first examination was given in October 1939 in Chicago, and 23 technicians were certified.

Since that time, 439 technicians have been certificated. The examining and qualifying of orthoptic technicians continues to be a major function of the American Orthoptic Council. The examinations have become increasingly comprehensive and discriminating. There is, however, need for further modification and improvement of the examination procedure.

In 1948, under the guidance of Dr. Walter B. Lancaster, the Council initiated the first training program in Maine, subsequently moving to Boston, St. Louis and Iowa City. During the past several years, an excellent intensive course in basic and practical subjects important to orthoptics has been given in Ann Arbor, Michigan through the efforts of Dr. John W. Henderson, with unusually fine results. These students complete a year with practical training under certificated technicians in various offices and clinics throughout the country.

In recent years, various universities have sponsored twelve-month (or longer) courses in orthoptics. New university sponsored courses have started within the past several years in Columbus, Houston, and Atlanta. This is a wholesome trend to be encouraged by the Council. The more orthoptics can align itself with well recognized academic and medical facilities, the more secure will be its position in education and ophthalmology.

Advising upon and guiding the professional activities of certificated technicians continues to be a major interest of the American Orthoptic Council. Advice upon technical, professional, and especially ethical matters is given upon request, and occasionally unsolicited. Since orthoptic technicians are not licensed, the Council acts as the informal regulating body for this important group of assistants in ophthalmics.

A continuing problem is one of recruiting greater numbers of capable and dedicated trainees in orthoptics, so that not only will the inactive technicians be replaced, but more and more well trained technicians will be available to the ophthalmological profession. There is no greater aid to the ophthalmologist in treating the strabismic patient than a good orthoptic technician.

FRANK D. COSTENBADER, M.D.

THE BASIC ORTHOPTIC COURSE

The American Orthoptic Council will again sponsor the Basic Course for Technicians this summer at the University of Michigan, Ann Arbor, under the direction of Dr. John W. Henderson and the Department of Ophthalmology. As usual, the faculty will be selected from various regions of the country and will be authorities in their fields. The period of instruction will be scheduled during the eight week Summer Session of the University of Michigan from June 26 to August 19, 1961, and is an official summer session course of the University. This year it will be required that a minimum of three months of practical training in orthoptics be completed before enrollment. It is hoped that this initial practical training will facilitate the students' understanding of the material presented in the basic course. Further, it will act as a preliminary screening method to ensure that students attending the course are interested in continuing in the field.

It is not necessary that the practical training taken after the basic course be completed in the same office or clinic in which the initial experience was gained. In fact, the Council feels that training in two different centers may be preferable.

There are a number of good orthoptic schools providing a full year of didactic training in one institution, and students from these schools are not required to take the Basic Course offered by the Council. General information relating to the various opportunities for orthoptic training is available in the brochure "A Profession in Orthoptics," which can be obtained from the Secretary of the American Orthoptic Council, Edmond L. Cooper, M.D., 414 David Whitney Building, Detroit 26, Michigan.

For further details concerning the Basic Summer Course sponsored by the American Orthoptic Council, please contact John W. Henderson, M.D., Room 6155 Outpatient Building, The University of Michigan Medical Center, Ann Arbor, Michigan. For those students requiring scholarship aid, application should be made to the National Scholarship Chairman for the Delta Gamma Foundation, Mrs. James E. O'Brien, 139 Hazel Avenue, Glencoe, Illinois, before April 1, 1961, the deadline for such applications.

JOHN W. HENDERSON, M.D.

INDEX TO VOLUMES I THROUGH X OF THE AMERICAN ORTHOPTIC JOURNAL

The first volume of the American Orthoptic Journal appeared in 1951. Since then this Journal has grown and flourished, and ten volumes have made their appearance, thanks to the interest of the profession and the unfailing assistance of the American Academy of Ophthalmology and Otolaryngology.

The material which has accumulated in the Journal is of value, but it is in danger of getting lost because of the difficulty in locating it. A cumulative index for the first ten volumes was called for in the opinion of this writer and has been worked out by Mrs. Elsie Laughlin, Chief

Orthoptist in the Department of Ophthalmology in the College of Medicine of the State University of Iowa. Thanks to the continued generosity of the American Academy of Ophthalmology and Otolaryngology and its Executive Secretary, Dr. William L. Benedict, this index will now be published as a supplement to volume 11 of the Journal. It is hoped that this index will greatly enhance the usefulness of the American Orthoptic Journal.

HERMANN M. BURIAN, M.D.

ORTHOPTIC SYLLABUS

One of the main tasks of the American Orthoptic Council is the supervision and organization of the training of orthoptic technicians. The American Orthoptic Council has set up regulations regarding this training. When these are fulfilled, the student is eligible to take the examination offered by the American Orthoptic Council. The Council also sponsors a two-month academic course in orthoptics and assists the members of the course in obtaining practical training. These efforts of the Council are insufficient in providing the country with the necessary number of orthoptists, however, and it welcomes the development of additional qualified orthoptic teaching centers.

The American Orthoptic Council also recognizes that it would be helpful in setting up teaching programs in orthoptics if a syllabus were available. Such a syllabus was published in 1948, but is no longer available and now needs revision. With the help of a number of ophthalmologists and orthoptists we have, therefore, developed a revised syllabus which has now been approved by the American Orthoptic Council and is soon to be published by the American Academy of Ophthalmology and Otolaryngology. The American Orthoptic Council is deeply grateful for this continuing support by the Academy.

HERMANN M. BURIAN, M.D.

AN ORTHOPTIC LIBRARY

As a basis for recommending acquisitions to an orthoptic library, a questionnaire was sent to a selected group of practicing orthoptists. From a given list of books they were asked to indicate their preferences based on two hypothetical situations:

1. You have been asked by a foreign government to establish an orthoptic clinic in a new hospital in a remote area which is accessible only by air. Your weight allowance permits the transport of only four books. You will be under contract to remain for two years. Which four orthoptic books would you select?

2. You have accepted a position in a Medical Center in a metropolitan area where you will be required to teach senior medical students, residents in ophthalmology, orthoptic students and student nurses. Which eight books would you choose to start your office library?

The total list of books offered for selection was as follows:

Physiology of the Eye	Adler
Strabismus Ophthalmic Symposium 1	Allen, Editor
Strabismus Ophthalmic Symposium 2	Allen, Editor
Amblyopia Reader	Dobson
The Practice of Refraction, Sections 3 and 4	Duke-Elder
Textbook of Orthoptics	Gibson
The Practice of Orthoptics	Giles, G. H.
Clinical Orthoptics	Kramer
The Human Eye in Anatomical Transparencies	Kronfeld and McHugh
A Manual of Orthoptics	Lancaster, Julia
Binocular Vision	Lancaster, Walter
Worth's Squint	Lyle and Bridgeman
Practical Orthoptics	Lyle and Jackson
The Science of Seeing	Mann and Pirie
The Oculorotary Muscles	Scobee
Rehabilitation of a Child's Eyes	Scobee and Katzin

The results of the questionnaire were as follows:

1. In the first situation, in which only four books were to be permitted:

Kramer	Clinical Orthoptics	31
Scobee	The Oculorotary Muscles	31
Adler	Physiology of the Eye	18
Lyle and Jackson	Practical Orthoptics	17

2. In the second situation, in which eight books were to be selected:

Scobee	The Oculorotary Muscles	40
Kramer	Clinical Orthoptics	38
Lyle and Jackson	Practical Orthoptics	29
Adler	Physiology of the Eye	29
Allen, Editor	Strabismus Symposium 2	28
Scobee and Katzin	Rehabilitation of a Child's Eyes	27
Lancaster, J.	A Manual of Orthoptics	22
Lyle and Bridgeman	Worth's Squint	21

The purpose of the questionnaire was three-fold. First, to assist the new orthoptist in the orderly acquisition of the most useful books with which to start her library. Second, to give the newly certified technician some insight regarding the value of certain textbooks as recommended by those with practical experience. Third, to stress the importance of organization in building a library.

Choices for inclusion in the first group were based upon completeness of material on all subjects, their practical aspect as well as theory, and as sources of reference material, vital for one located in an isolated area. These books in the second group were selected on the same criteria as well as for their value as teaching books, and as contemporary works and opinions.

It is indeed unfortunate that at this time the two most popular books, those by Scobee and Kramer, are out of print. It is to be hoped that both of these texts will soon be revised and made available in new editions.

MABEL EDE

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Midwestern—Chicago, Illinois
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ABSTRACTS OF OPHTHALMIC LITERATURE

Arruga, Alfredo, and Downey, Rachel: *Simple modification of synoptophore*, Amer J Ophthal, 50:156-158 (July) 1960.

The authors describe three additions to the synoptophore which may be utilized in the treatment of eccentric fixation; rotating slides for an anti-suppression exercise, a rotating polarizer with blue-violet filter for creating the Haidinger brush phenomenon, and an iris diaphragm to effectively decrease the field in the treatment of anomalies of localization.

Arruga, Alfredo, and Downey, Rachel: *Anomalous sensory relationship in apparently cured squints*, Brit J Ophthal, 44:492-502 (Aug.) 1960.

The authors describe in detail tests combining the visuscope, euthyscope, afterimage and Haidinger brush phenomenon which detect small angle anomalies with anomalous correspondence in apparently cured squints. They feel that early surgical treatment is at fault in precipitating many of these squints and that, except in extreme cases, treatment should be confined to alternate patching until the patient is old enough for a valid sensorial and motor evaluation.

Blodi, Frederick C., and Van Allen, Maurice W.: *The effect of paralysis of the cervical sympathetic system on the electromyogram of extraocular muscles in the human*, Amer J Ophthal, 49:679-683 (April) 1960.

Electromyograms of the extraocular muscles of eight patients before, during and after cervical sympathetic paralysis effected by stellate ganglion block, were done with particular reference to the levator muscle. The authors conclude that induced paralysis of the cervical sympathetic system produced no consistent effect on the electrical activity of the levator muscle and that it is unlikely that control is exerted via the sympathetic system.

Byron, Herve M.: *Results of pleoptics in the management of amblyopia with eccentric fixation*, AMA Arch Ophthal, 63:675-681 (April) 1960.

Four pleoptic instruments developed by Cüppers are described. Factors in selecting suitable patients and results from pleoptic treatment are discussed.

Chabot, Jacqueline: *Remarques sur le pronostic des fixations excentriques chez le jeune enfant [Observations on the prognosis of young children with eccentric fixation]*, Bull Soc Ophthal Franc, 5:234-238 (April) 1960.

The importance of early treatment by occlusion in strabismic amblyopia is discussed. The suggestion is made that when a small degree of eccentric fixation is present, occlusion of the better eye may not be contraindicated if the patient is young enough and close surveillance is possible. Nine cases are presented in which occlusion of the fixing eye led to a return of centric fixation in the deviating eye, and in some of these cases eventual alternation and/or equal visual acuity was achieved. The author feels that the primary factor in the successful treatment of these patients was early occlusion before the eccentric fixation could become firmly established.

Chesnais, A.: *Strabismus in identical twins*, Ann Oculist (Par), 193:501-515 (June) 1960.

A survey of ninety-two cases of identical twins indicates that a casual hereditary factor is present in strabismus. No conclusion, however, as to the nature and extent of this hereditary factor can be reached other than to recognize that ametropia is hereditary, and that strabismus is often linked to the presence of ametropia. Amblyopia, also, seems to the author to be a complication linked to the ametropia, especially when a squint is present.

Cowan, Eric C.: *A simple apparatus for the diagnosis and recording of diplopia*, Brit J Ophthal, 44:59-63 (Jan.) 1960.

The author has devised a simple and efficient apparatus for recording and diagnosing diplopia fields in patients to whom the standard tests are not applicable.

Dunlap, Edward A.: *Selection of operation procedures in vertical muscle deviations*, AMA Arch Ophthal, 64:167-174 (Aug.) 1960.

The author enumerates his procedures of choice for surgical correction in different types of vertical deviations. In vertical paresis the first procedure should be performed on the nonfixing eye. However, if the imbalance is predominantly in the lower field, then the underacting muscle should be strengthened, regardless of which eye is fixing. If a vertical deviation exists simultaneously with a horizontal one, the larger deviation should be corrected first; the lesser one may need no further procedure. If surgery on the superior and inferior recti is performed, one should keep in mind that small amounts of correction yield relatively large results. In A and V syndromes with alternating fixation, the secondary deviators should first be weakened.

Görtz, Heinz: *The corrective treatment of amblyopia with eccentric fixation*, Amer J Ophthal, 49:1315-1321 (June) 1960.

The aims of the treatment of amblyopia with eccentric fixation are stated, and the methods by which the treatment is carried out are described. Eighty-eight cases of amblyopia with eccentric fixation are reported on, with respect to fixation, monocular localization, visual acuity, retinal correspondence and the degree of binocularity obtained after treatment.

Krimsky, Emanuel: *A modified Prince rule*, Amer J Ophthal, 49:827-829 (April) 1960.

The bifurcated Krimsky-Prince bar was designed to simplify the readings of accommodation near point and convergence near point. A description of how to use the modified Prince rule is given. A table of the normal accommodation in diopters is included.

Lavat, J.: *A propos de la cure d'un strabisme avec double hyperphori [Apropos of the cure of strabismus with double hyperphoria]*, Bull Soc Ophthal Franc, 1:14-21 (Jan.) 1960.

The technique of measuring double hyperphorias both with prisms and with the major amblyoscope is described, and a case history is presented in which orthoptics and surgical treatment were successfully combined to effect a cure.

Magee, Alfred J.: *Minimal values for the A and V syndromes*, Amer J Ophthal, 50:753-756 (Nov., pt. I) 1960.

After a study of one hundred nonstrabismic patients, the author concludes that the incidence of the A and V or H syndrome (anisophoria) is common and that in this type, neither the vertical deviation nor overaction or underaction of horizontal muscles appears to offer the cause of the condition. An arbitrary figure of a difference of 20 prism diopters between up and down positions constitutes a V exophoria, and a difference of 5 prism diopters constitutes an A exophoria. It is suggested that the ideal method of measuring for the syndromes is to maintain the patient's head in the horizontal plane rather than to tilt the head up and then down.

Massie, H. H.: *Ophthalmoscopic attachment for the diagnosis of eccentric fixation*, Brit J Ophthal, 44:189-191 (March) 1960.

The author describes a pale green filter (no. 21 pea-green) in which there is a central uncolored hole of 3/1,000 of an inch, which may be fitted to most ophthalmoscopes in the manner of a visuscope to enable the doctor to determine the fixation pattern for the early diagnosis of eccentric fixation.

Matteucci, Pellegrino: *Strabismic amblyopia*, Brit J Ophthal, 44:577-582 (Oct.) 1960.

The clinical picture of strabismic amblyopia is described and the problem of whether or not sensory or motor phenomena are the causative factors is discussed. The authors feel that strabismic amblyopia represents a genuine syndrome of sensory-motor incoordination. The sensory disturbance is represented by deficiency of binocular vision, deficiency of visual acuity, and difficulty of separation; the motor disturbance by strabismic deviation, deficiency of fixation, and motor incoordination involving other parts of the body.

Matteucci, P.: *Motor difficulties in strabismic amblyopia*, Ann Oculist (Par), 193:641-649 (Aug.) 1960.

The author's hypothesis is that some instability of fixation is present in all cases of strabismic amblyopia and that the cause is motor as well as sensory. Electromyographical studies of amblyopic eyes in strabismus and in anisometropia would seem to indicate that fixation is always unstable in an amblyopic eye in strabismus. The characteristic findings of "separation difficulty" and false projection present in eccentric fixation and not found in any other type of amblyopia also indicate that this type of amblyopia differs from any other. The author concludes that strabismic amblyopia is a distinct syndrome of sensory-motor incoordination and that the motor component of this syndrome must be emphasized more fully.

Matteucci, P., and Pasino, L.: *The meaning of instability and eccentric fixation in strabismic amblyopia*, Ann Oculist (Par), 193:733-738 (Sept.) 1960.

On the basis of clinical observations and electromyographical findings, the authors conclude that deficient fixation is always present in cases of strabismic amblyopia, although ordinary diagnostic procedures cannot always detect it. Deficient fixation is defined as an incapacity of the amblyopic eye to receive the image of the fixated object on the fovea so that the normal retinocortical connections are no longer operative. The one-to-one arrangement of cones and neurons in the fovea means that fixation which is even minutely unstable can produce diminished visual acuity. This defect in fixation is linked to the motor incoordination caused by the ocular deviation and can be modified by a surgical procedure to eliminate the squint.

Matteucci, P.; Pasino, L., and Cordella, M.: *Criticism of Harms' theory on persistent inhibition in an amblyopic eye with strabismus*, Ann Oculist (Par), 193:485-492 (June) 1960.

An analysis of the neurophysiologic basis for Harms' theory of suppression in strabismic amblyopia and a discussion of the therapeutic principles of the afterimage by Cüppers is given. The authors feel that research which has led to the belief in the persistence of monocular suppression is inconclusive and open to criticism, and that the effectiveness of Cüppers' treatment comes from a re-education of normal sensory-motor coordination rather than from any active breakdown of suppression in the amblyopic eye.

McLaughlin, Samuel C., Jr.: *An hypothesis concerning the etiology of nonparalytic strabismus*, Amer J Ophthal, 49:1218-1221 (May, pt. II) 1960.

The author presented the following hypothesis: If a child four months of age has a temporary or remediable obstacle to fusion, e.g., delayed myelinization of the oculomotor fibers, he will have diplopia and gradually learn that one of the two images is unreal. Then, even after the motor obstacle to fusion has been eliminated, the fact that he has one "real" and one "unreal" image will still be an obstacle to fusion. All further symptoms can be explained on the basis of this hypothesis.

Miller, James E.: *A comparison of miotics in accommodative esotropia*, Amer J Ophthal, 49:1350-1355 (June) 1960.

A comparison of isoflurophate (DFP) with (1) echothiophate (Phospholine) iodide, (2) demecarium bromide (Humorsol) and (3) Mintacol, leads to the conclusion that these drugs with the exception of Mintacol, are as effective as DFP in the treatment of accommodative esotropia. In addition, they are water soluble, while DFP is not, and demonstrate a lower incidence of iris cyst development. The observation is made that tolerance to miotics may occur irrespective of which miotic is employed.

Miller, James E.: *Vertical recti transplantation in the A and V syndromes*, AMA Arch Ophthal, 64: 175-179 (Aug.) 1960.

Symmetrical 7 mm. horizontal transplantation of the vertical recti is reported. In the A type of esodeviation, the superior rectus is transplanted 7 mm. temporally in each eye, and in the V type of esodeviation, the inferior recti are transplanted temporally, to create function as secondary abductors in the respective fields. In exotropia the vertical recti are transplanted nasally—in the A type of exodeviations, the inferior rectus, and in the V type of exodeviation, the superior rectus—to increase their secondary adduction.

Pincon, Francoise: *Sur quelques cas de traitement d' amblyopies functionnelles [Report on the treatment of functional amblyopia with the pleoptophore]*, Bull Soc Ophthal Franc, 5:238-243 (April) 1960.

A report of seven cases of strabismic amblyopia with eccentric fixation which were treated with the pleoptophore with encouraging results.

Rambo, Victor C., and Sangal, S. P.: *A study of the accommodation of the people of India*, Amer J Ophthal, 49:993-1004 (May) 1960.

A survey of the status of accommodation in East Indian males is presented. Methods and statistics are given, and the hypothesis is made that an "average" age for presbyopia does not exist but that it may vary with the populations in different areas of the world. The conclusion is reached that accommodation fails more rapidly and presbyopia occurs about eight years earlier in Indian males than in mid-European. One should no longer speak of the "presbyopic age" but of the "presbyopic ages."

Shrader, Edward C., and Schlezinger, N. S.: *Neuro-ophthalmologic evaluation of abducens nerve paralysis*, AMA Arch Ophthal, 63:84-91 (Jan.) 1960.

A survey of patients with an isolated acquired abducens nerve paralysis was reviewed from the standpoint of etiology and prognosis. No definitive diagnosis was apparent in almost half of the one hundred and four patients seen, although it was believed that the etiologic factor in 21 per cent of this group was vascular. The various causes, in order of their relative frequency, were diabetes mellitus, multiple sclerosis, syphilis, neoplasm, neuritis, and trauma. The causes were equally divided in sex incidence and in lateralization of involvement. The average duration of the abducens paralysis in each group was also discussed.

Smith, Byron, and Soll, David B.: *Strabismus associated with thyroid disease*, Amer J Ophthal, 50:473-478 (Sept.) 1960.

Diplopia secondary to thyroid disease is discussed. The physiology of the thyroid gland and its relationship to extraocular muscle disturbances is described. Three case histories are presented in which surgical correction of the stabilized deviation was successfully performed.

Stein, Conrad: *Strabismus in the child: an expression of shame*, Ann Oculist (Par), 193:590-596 (July) 1960.

A study of strabismic children by a psychoanalyst reveals that a possible cause of the deviation may be the child's wish to be punished for hidden "Oedipus" desires. The ridicule which the cross-eyed child receives provides the punishment he is seeking for these unacceptable desires, and the squint then becomes an expression of the need to be punished. In this author's view, the shame and embarrassment which are caused by squinting are not a consequence of the squint but are motivating factors in causing the strabismus. The ophthalmologist should be aware of this potential obstacle to the cure of the deviation.

Taylor, Daniel M.: *Effective management of strabismus*, Amer J Ophthal, 50:757-764 (Nov., pt. I) 1960.

The article was written in an effort to present a practical, effective approach to strabismus for the ophthalmologist who does not have a technician and is not practicing in a large center. A careful diagnostic work-up, utilization of refractive correction, occlusion, and early surgery are recommended as the best available means with which to bring about a functional result.

The point is made that for the ophthalmologist practicing in outlying areas, strabismus is primarily a surgical problem rather than a medical one.

Urist, Martin J.: *Divergence excess combined with convergence excess in the V-syndrome*, Amer J Ophthal, 50:765-782 (Nov., pt. I) 1960.

A presentation of nine cases of divergence excess with exotropia for distance and upward gaze, combined with convergence excess with esotropia for near and downward gaze. The latent divergence excess can be masked by a manifest convergence excess, and straight eyes can be maintained part of the time due to the innervational balance between these opposite kinds of deviation. The basis for the diagnosis of latent divergence excess is the occasional presence of straight eyes for distance and upward gaze. Surgical correction, when indicated, must aim at relieving only enough convergence excess to allow a gradual innervational adjustment to take place or else the result will be an overcorrection and consequent exotropia.

von Noorden, Gunter K., and Burian, Hermann M.: *Perceptual blanking in normal and amblyopic eyes*, AMA Arch Ophthal, 64:817-822 (Dec.) 1960.

If a tachistoscopic stimulus containing information to be perceived is followed by a bright flash of light, the flash will obliterate the perception of the information under certain conditions. Perceptual blanking as a method to determine the amount of perceptual interference in strabismic amblyopia was reported on. The experiment was carried out on 7 subjects with normal visual acuity and 6 patients with amblyopia. With the set-up and procedure employed, the perceptual time was found to be 30 msec.; blanking occurred at 23 msec. It was discovered that the average response in the amblyopic eyes was delayed as compared to the normal eyes.

Wybar, Kenneth, and Thatcher, Barbara: *Significance of eccentric fixation in squint*, Brit J Ophthal, 44: 472-491 (Aug.) 1960.

This is a comprehensive article on the means and significance of the treatment of eccentric fixation by pleoptic methods. A neurophysiologic explanation of amblyopia ex anopsia is given, the distinction between amblyopia of arrest and amblyopia of extinction according to Chavasse is described, and the origin of eccentric fixation in view of these concepts is postulated. Methods of pleoptic diagnosis and treatment, including descriptions of the visuscope, euthyscope, coordinator and synoptophore, are given. Finally, a discussion of the value and limitations of pleoptics is presented.

1961
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